US009471029B2

(12) **United States Patent**
Itabashi et al.

(10) **Patent No.: US 9,471,029 B2**
(45) **Date of Patent: *Oct. 18, 2016**

(54) **CARTRIDGES INCLUDING DETECTION MEMBER AND COVER MEMBER**

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(73) Assignee: **Brother Kogyo Kabushiki Kaisha**, Nagoya-shi, Aichi-ken (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/703,804**

(22) Filed: **May 4, 2015**

(65) **Prior Publication Data**

US 2015/0309470 A1 Oct. 29, 2015

Related U.S. Application Data

(63) Continuation of application No. 14/032,259, filed on Sep. 20, 2013, now Pat. No. 9,046,869.

(30) **Foreign Application Priority Data**

Sep. 21, 2012 (JP) 2012-208910

(51) **Int. Cl.**

G03G 21/16	(2006.01)
G03G 21/18	(2006.01)
G03G 15/08	(2006.01)

(52) **U.S. Cl.**

CPC ***G03G 21/1652*** (2013.01); ***G03G 15/0863*** (2013.01); ***G03G 15/0896*** (2013.01); ***G03G 21/1604*** (2013.01); ***G03G 21/1867*** (2013.01); ***G03G 21/1896*** (2013.01)

(58) **Field of Classification Search**

CPC G03G 21/1867; G03G 21/1604; G03G 21/1896; G03G 21/1652

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,978,997 B2	7/2011	Tokuda
8,843,014 B2	9/2014	Itabashi et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN	102968030 A	3/2013
EP	2423760 A2	2/2012
JP	2006-267994 A	10/2006

OTHER PUBLICATIONS

State Intellectual Property Office of the People's Republic of China, Notification of First Office Action for Chinese Patent Application No. 201310425704.9 (counterpart to U.S. Pat. No. 9,046,869, which is a parent of the above-captioned patent application), mailed Oct. 9, 2015.

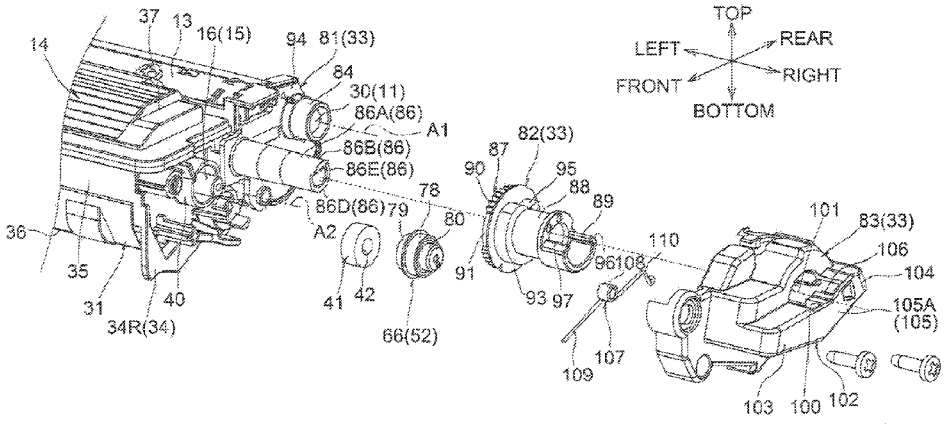
Primary Examiner — Sandra Brase

(74) *Attorney, Agent, or Firm* — Baker Botts L.L.P.

(57) **ABSTRACT**

Cartridges may include a developing roller, an electrode, a detection member, and a cover member. The developing roller rotates about an axis extending along a first direction. The electrode includes a protrusion that protrudes along the first direction to an end portion. The detection member includes a cover portion, which covers an exposable portion of the protrusion when the detection member is in a first position, and which exposes the exposable portion of the protrusion when the detection member is in a second position. The cover member covers a portion of the detection member and exposes the cover portion when the detection member is in the first position. The cover member extends in the first direction to an end portion. An overlap portion of the protrusion extends at least to the end portion of the cover member and overlaps a portion of the cover member in a second direction.

11 Claims, 23 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

9,046,869 B2 * 6/2015 Itabashi G03G 21/1604
2006/0193646 A1 8/2006 Suzuki et al.
2011/0243578 A1 * 10/2011 Ukai G03G 21/1896 399/12
2013/0051813 A1 2/2013 Itabashi et al.

* cited by examiner

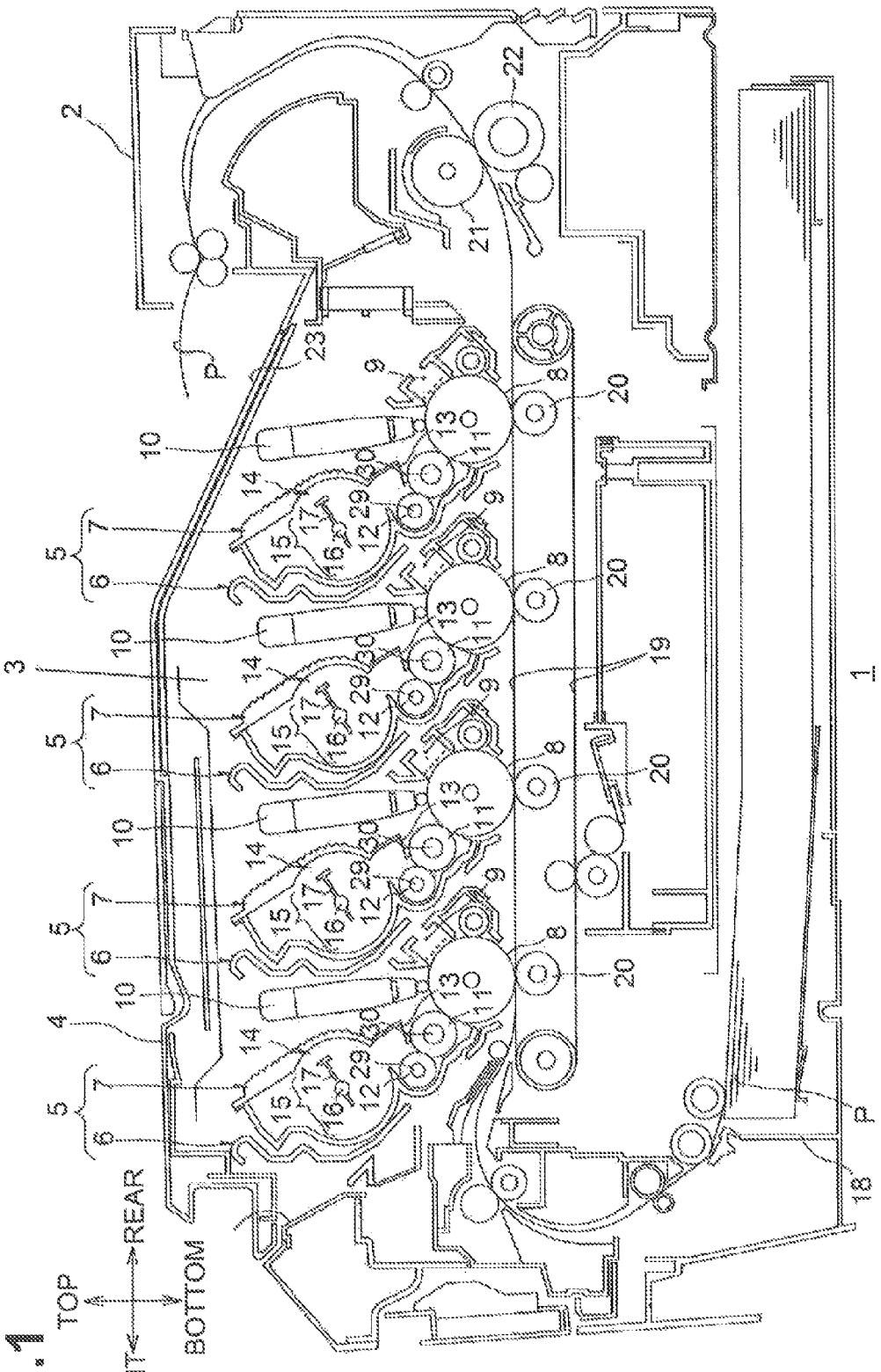


Fig.1

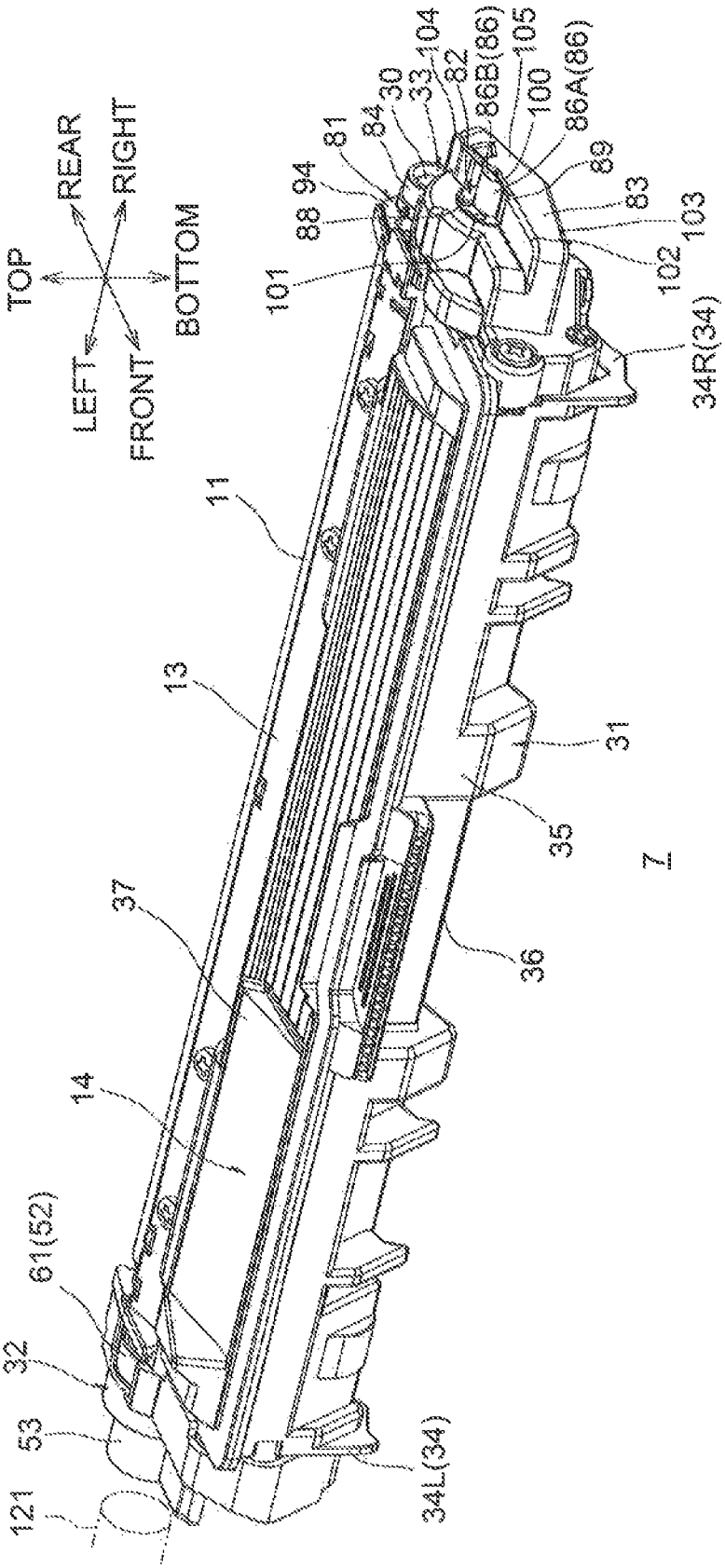

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Fig.2

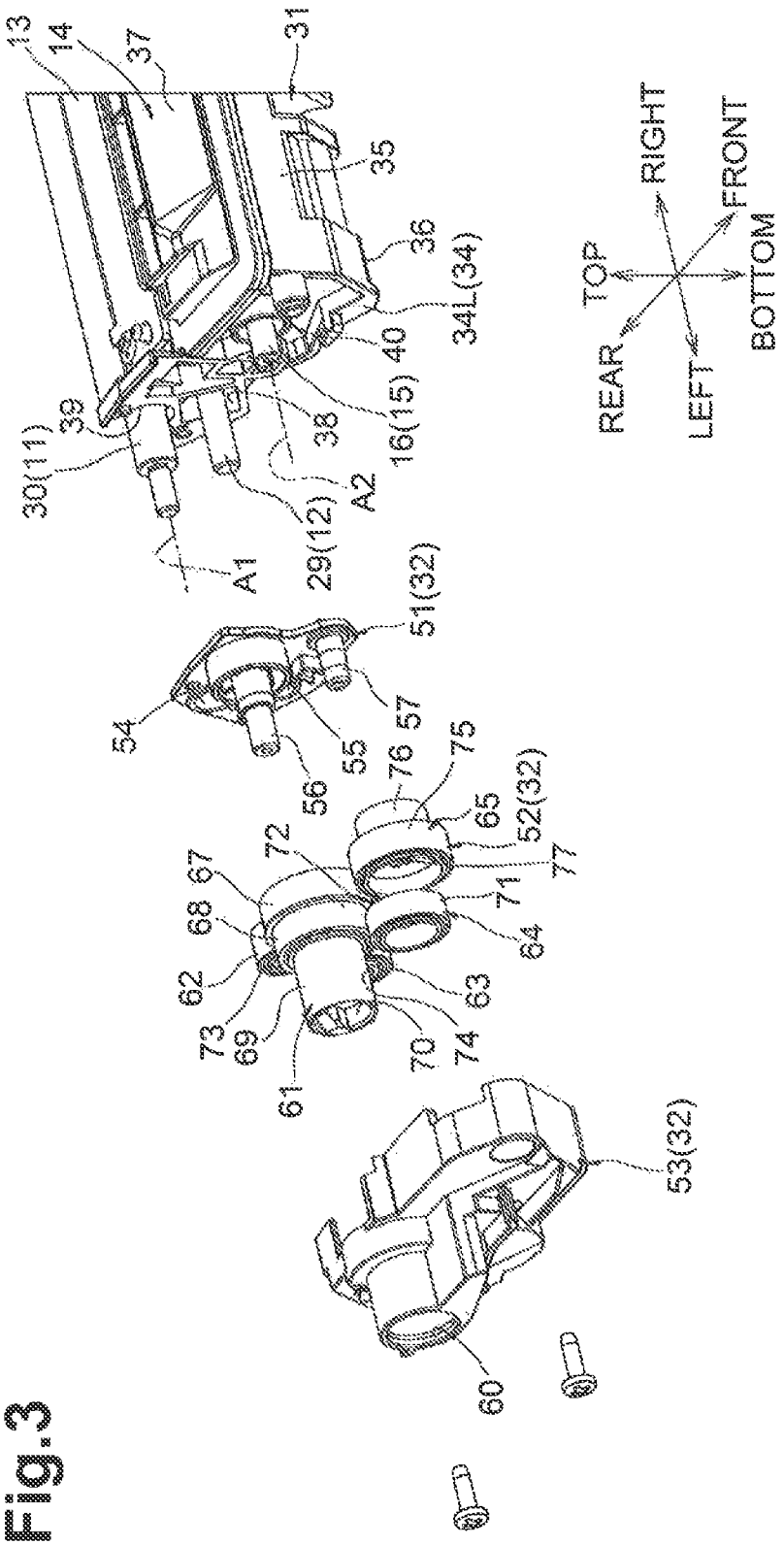
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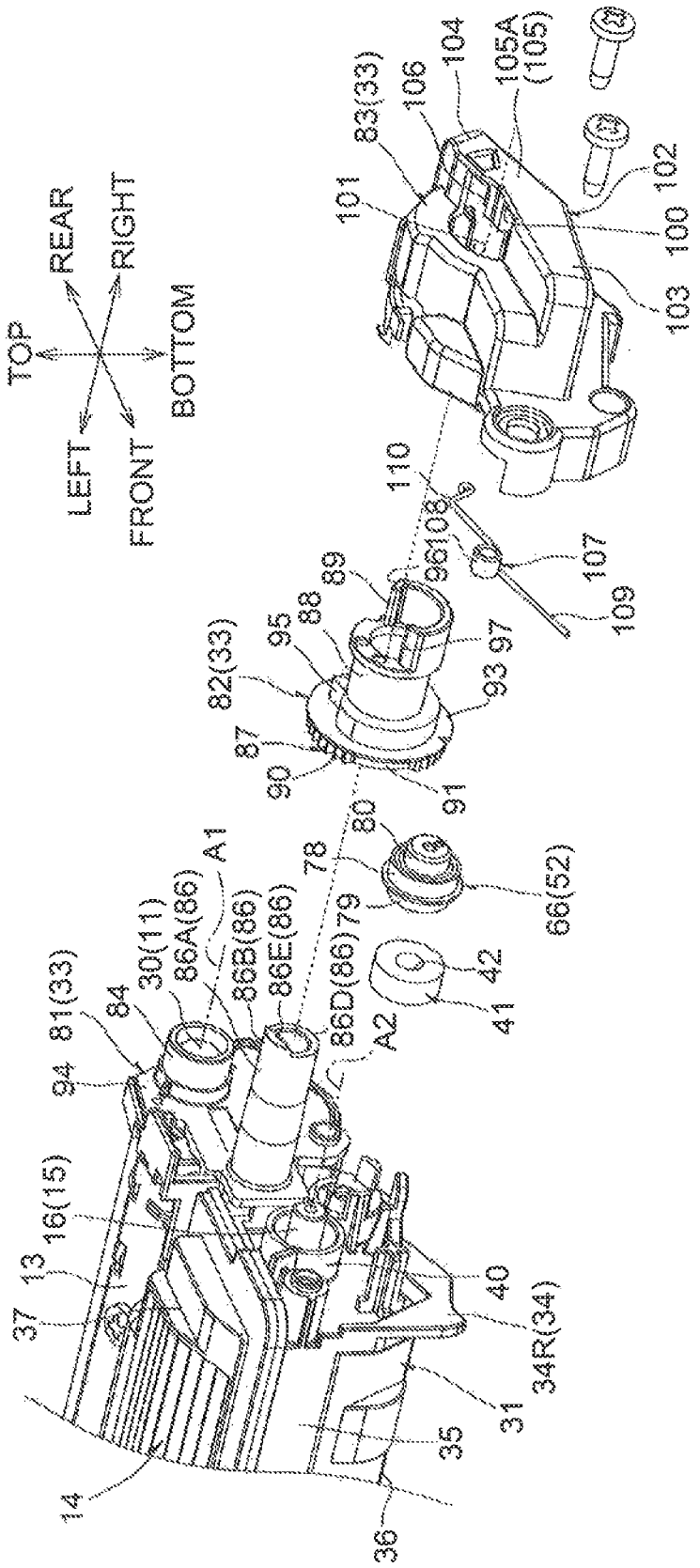
Fig.3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A1
30(11)
86A(86)
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86E(86)
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34R(34)
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Fig.4

Fig.5A

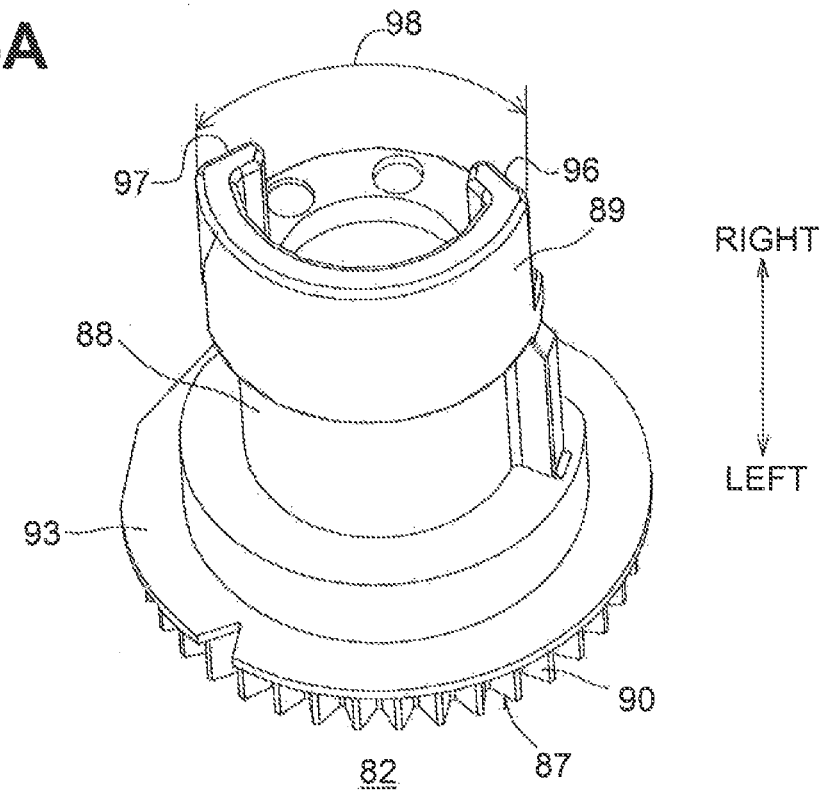
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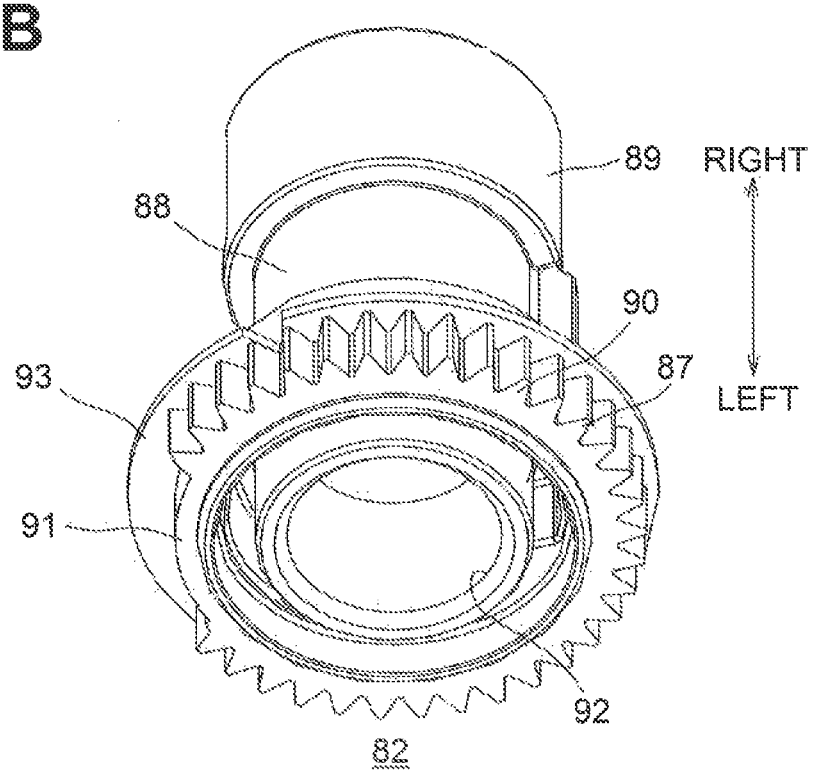
Fig.5B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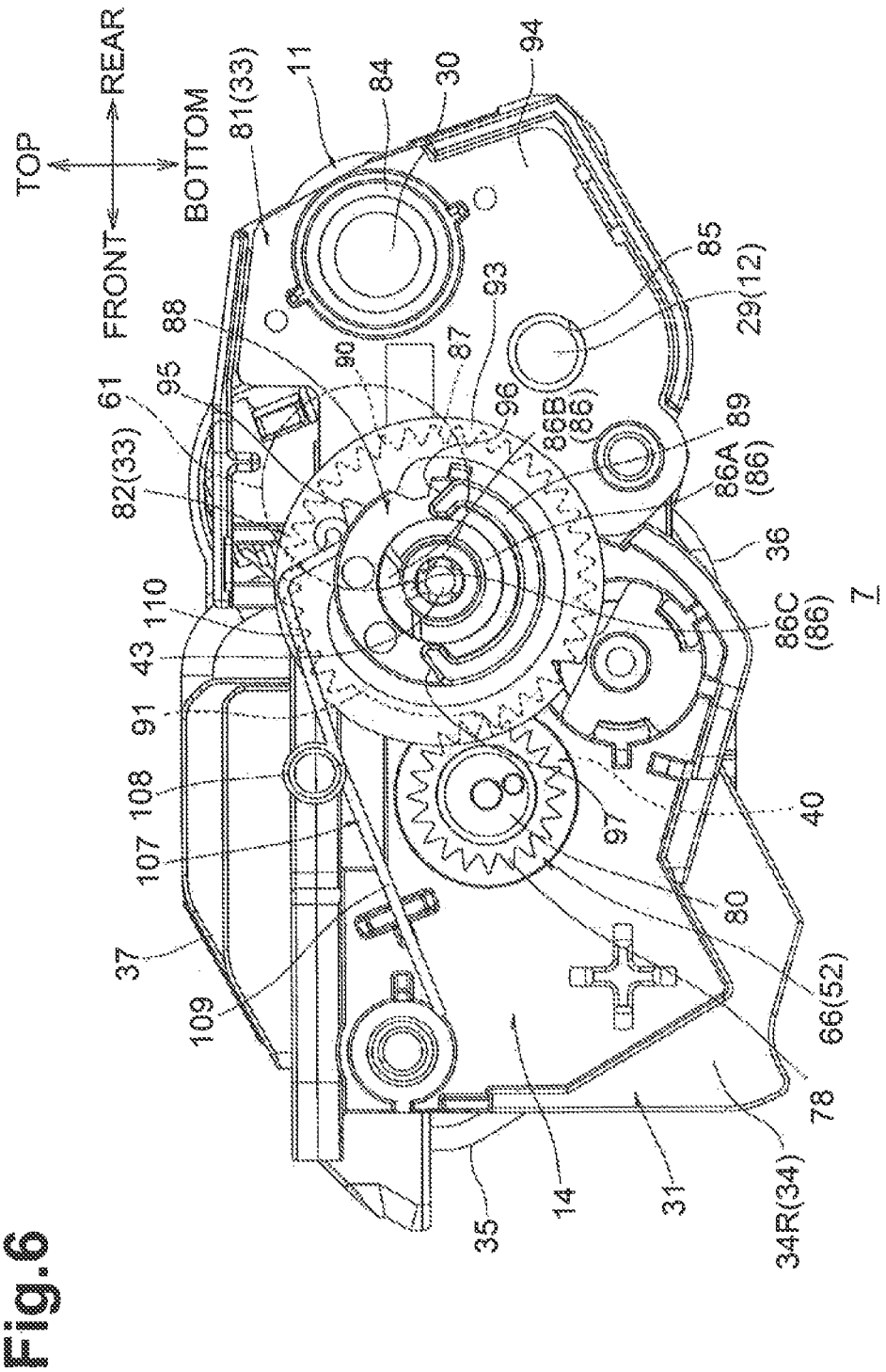
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Fig.6

Fig.7A

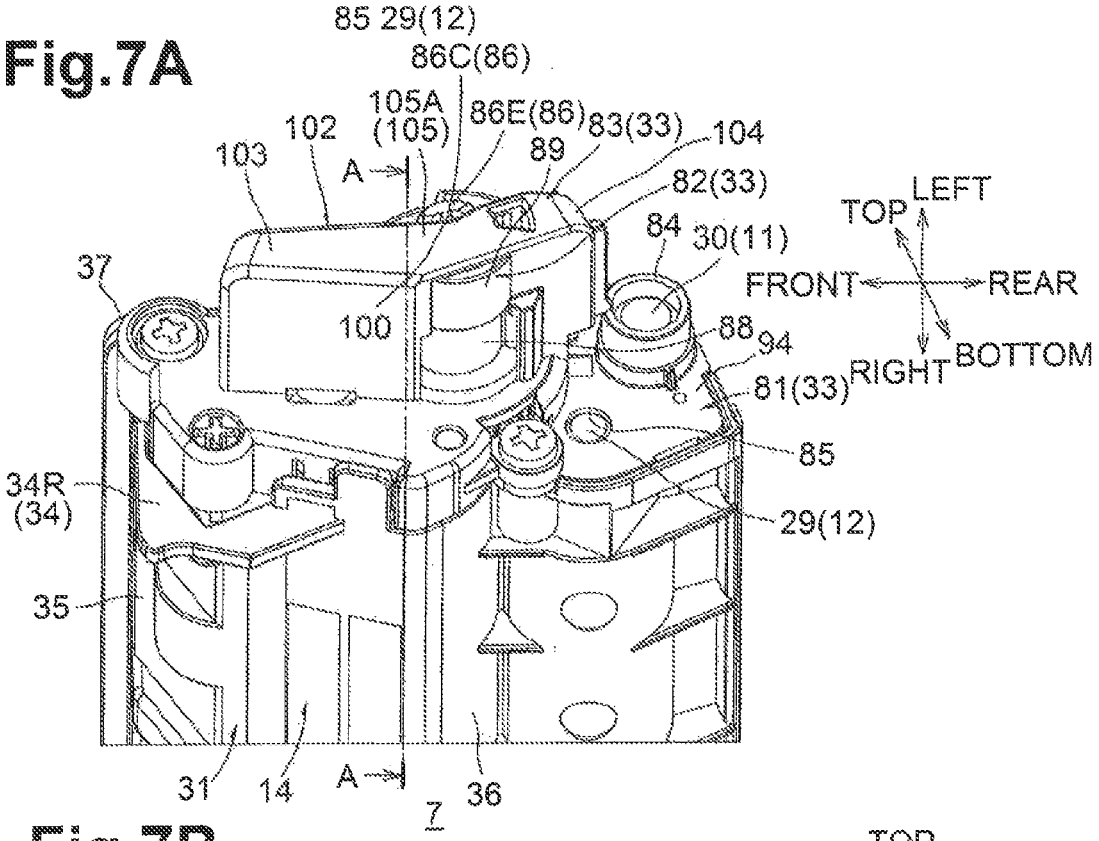
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Fig.7B

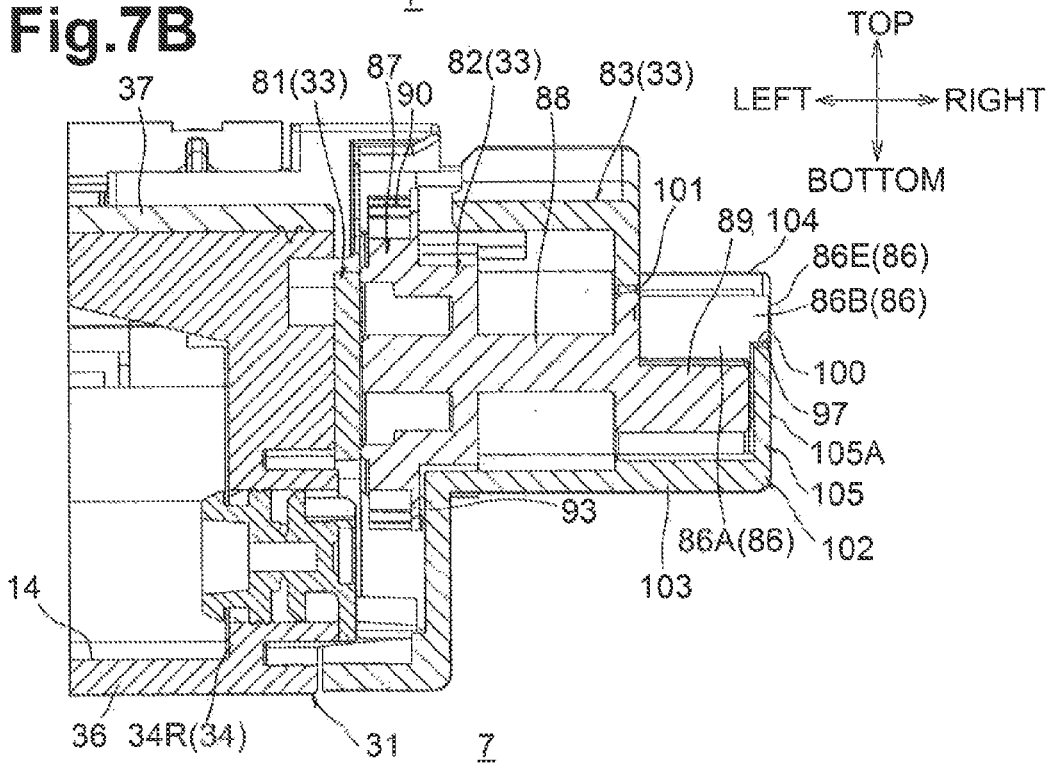
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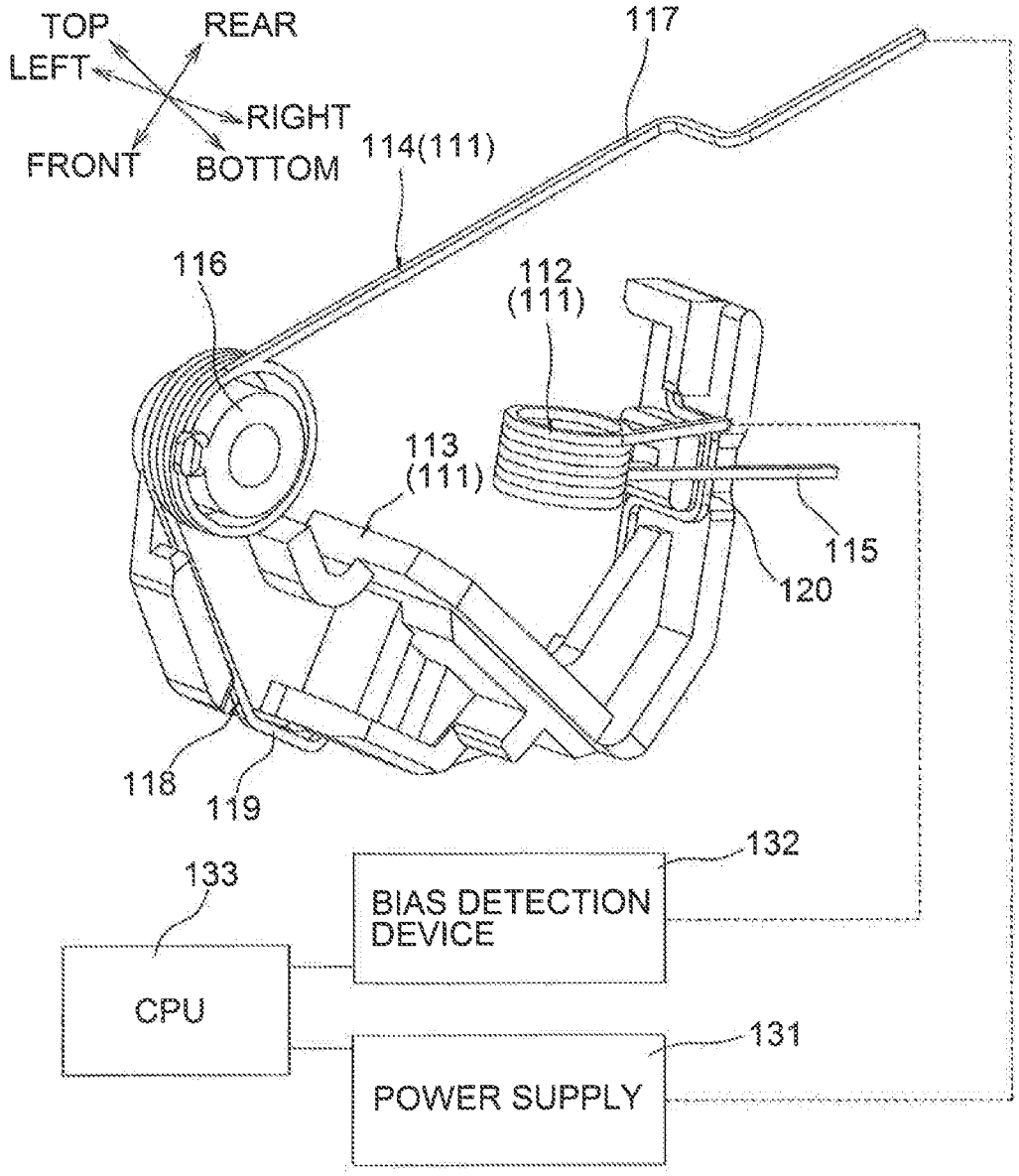
Fig.8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BIAS DETECTION DEVICE
CPU
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POWER SUPPLY

Fig.9

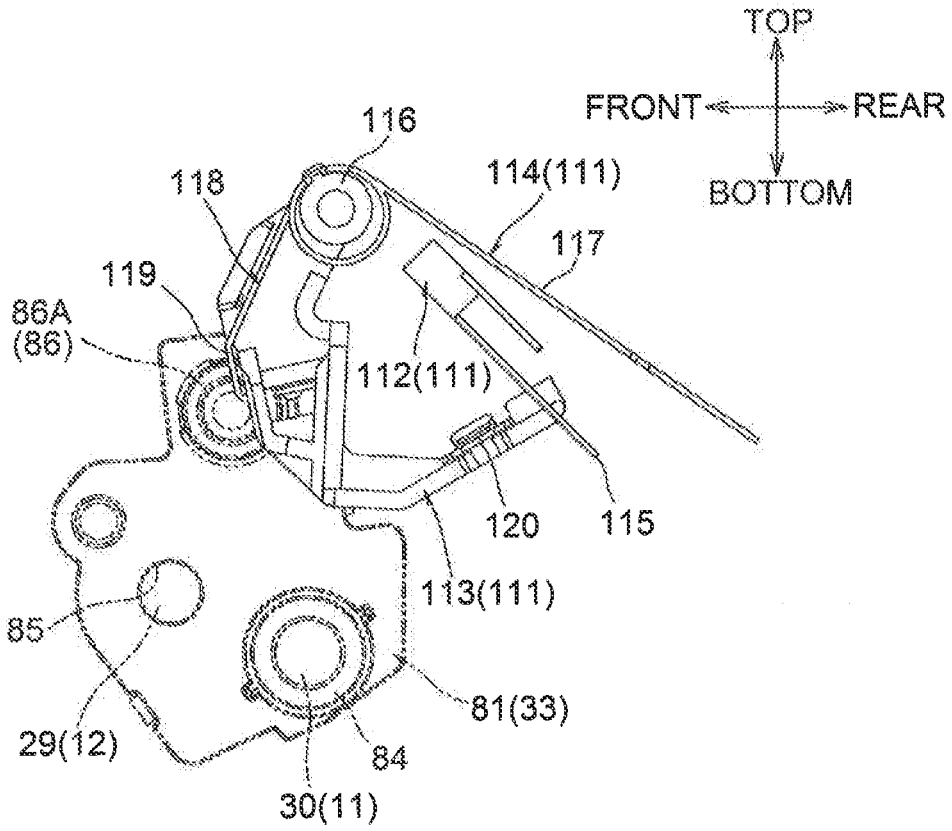
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Fig.10

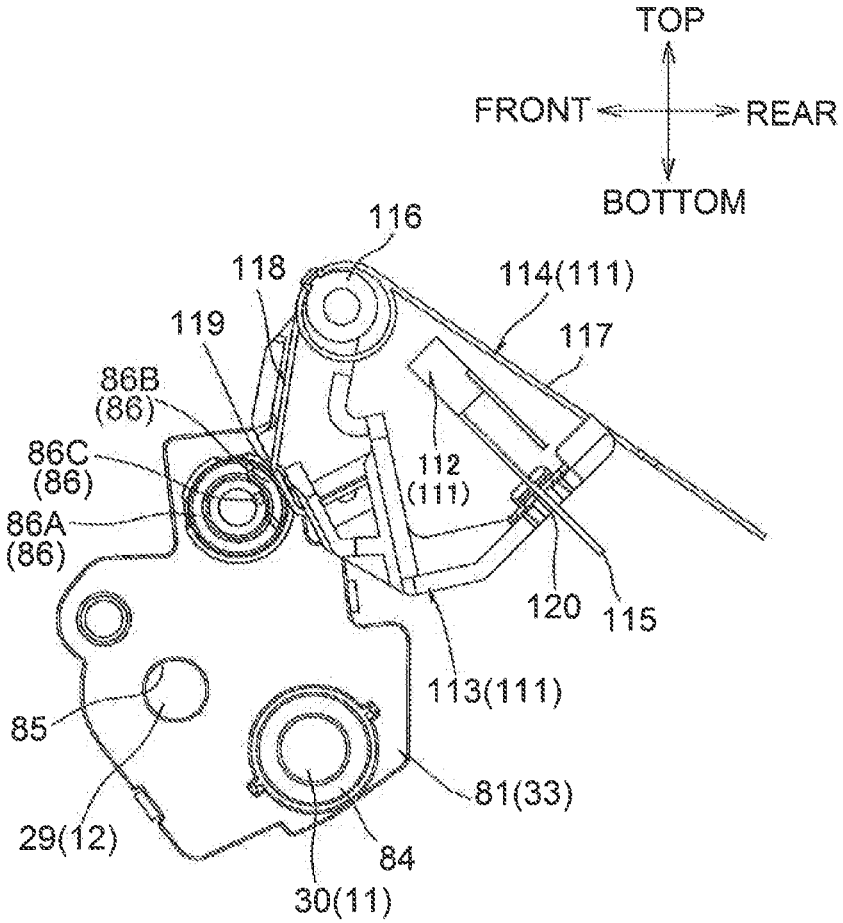
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Fig.11

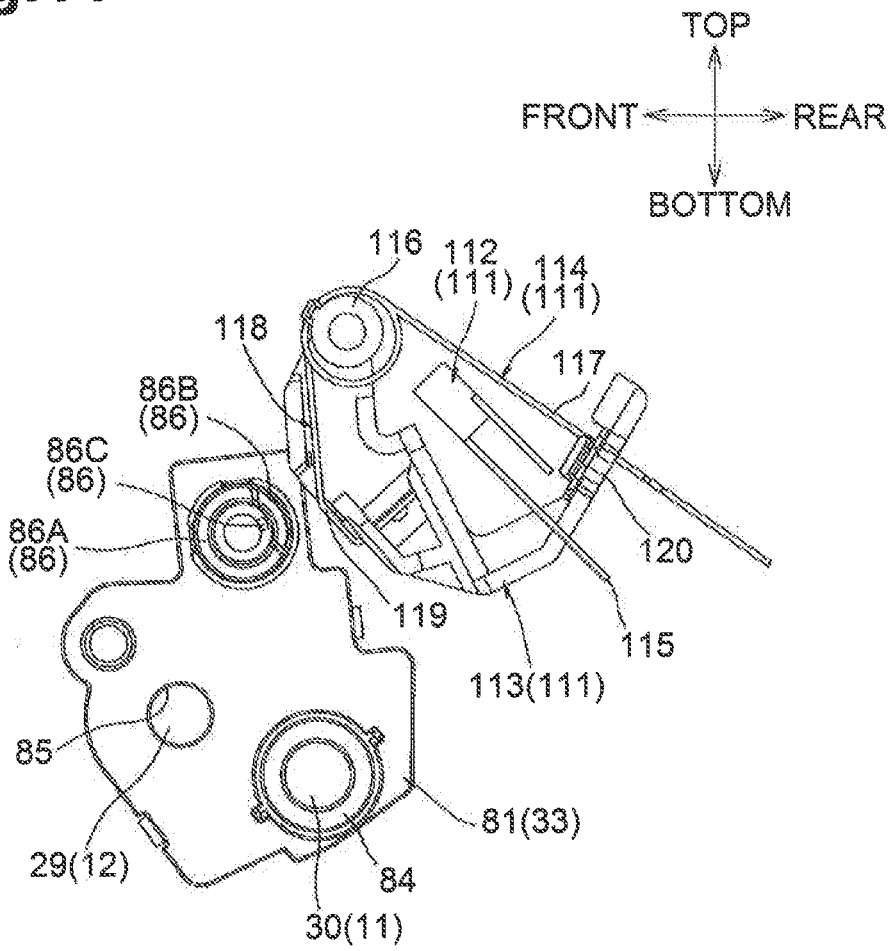
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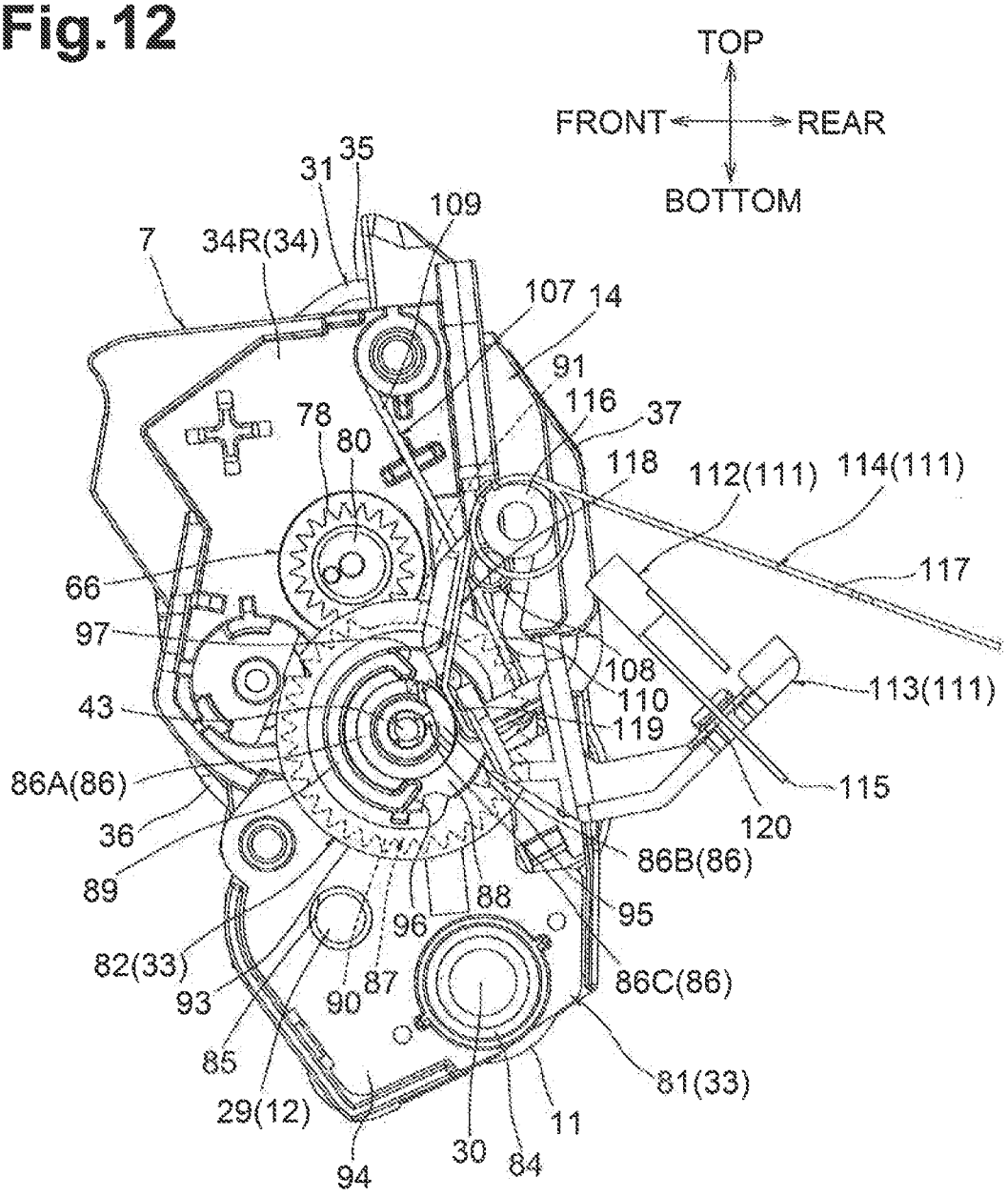
Fig.12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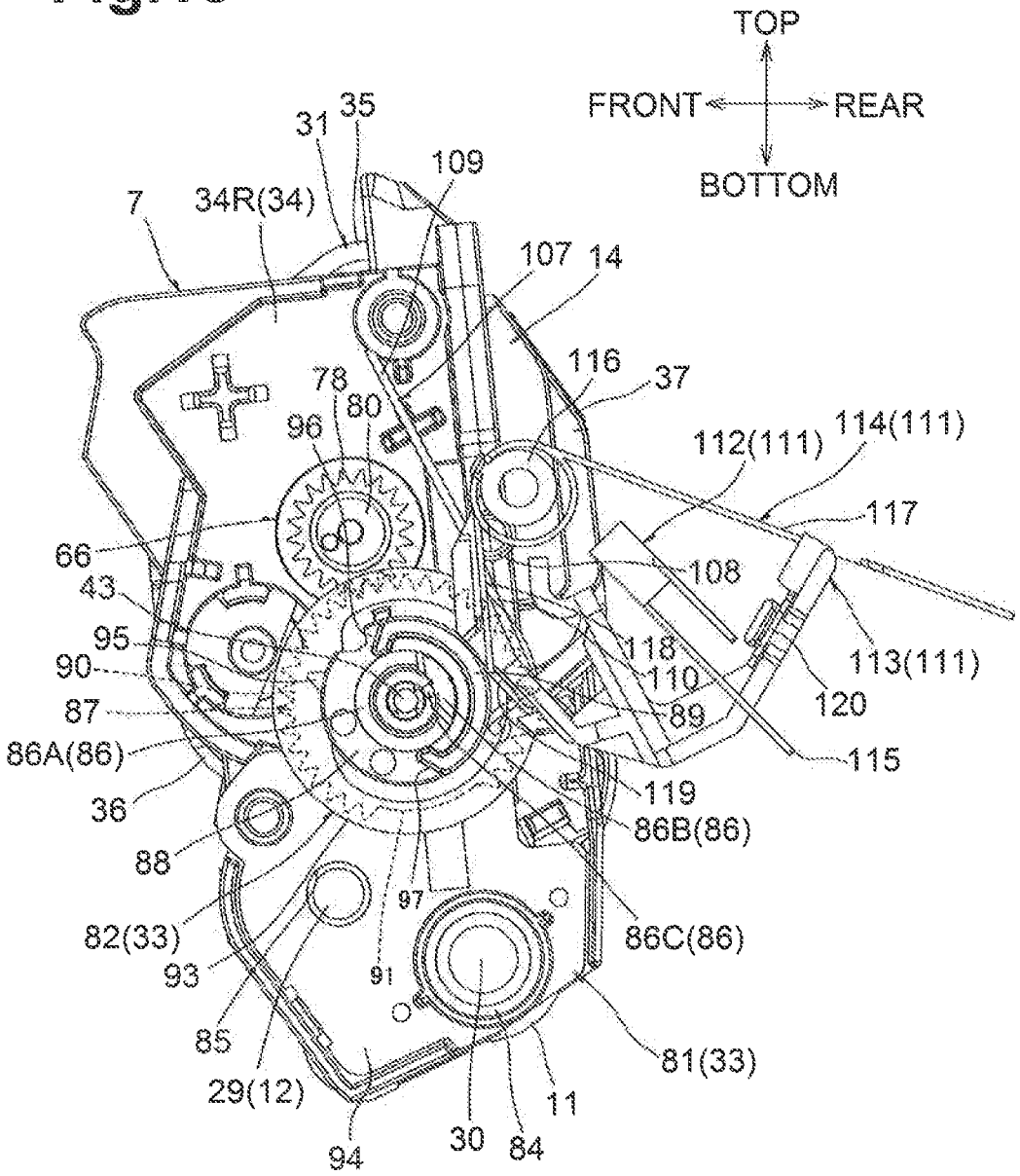
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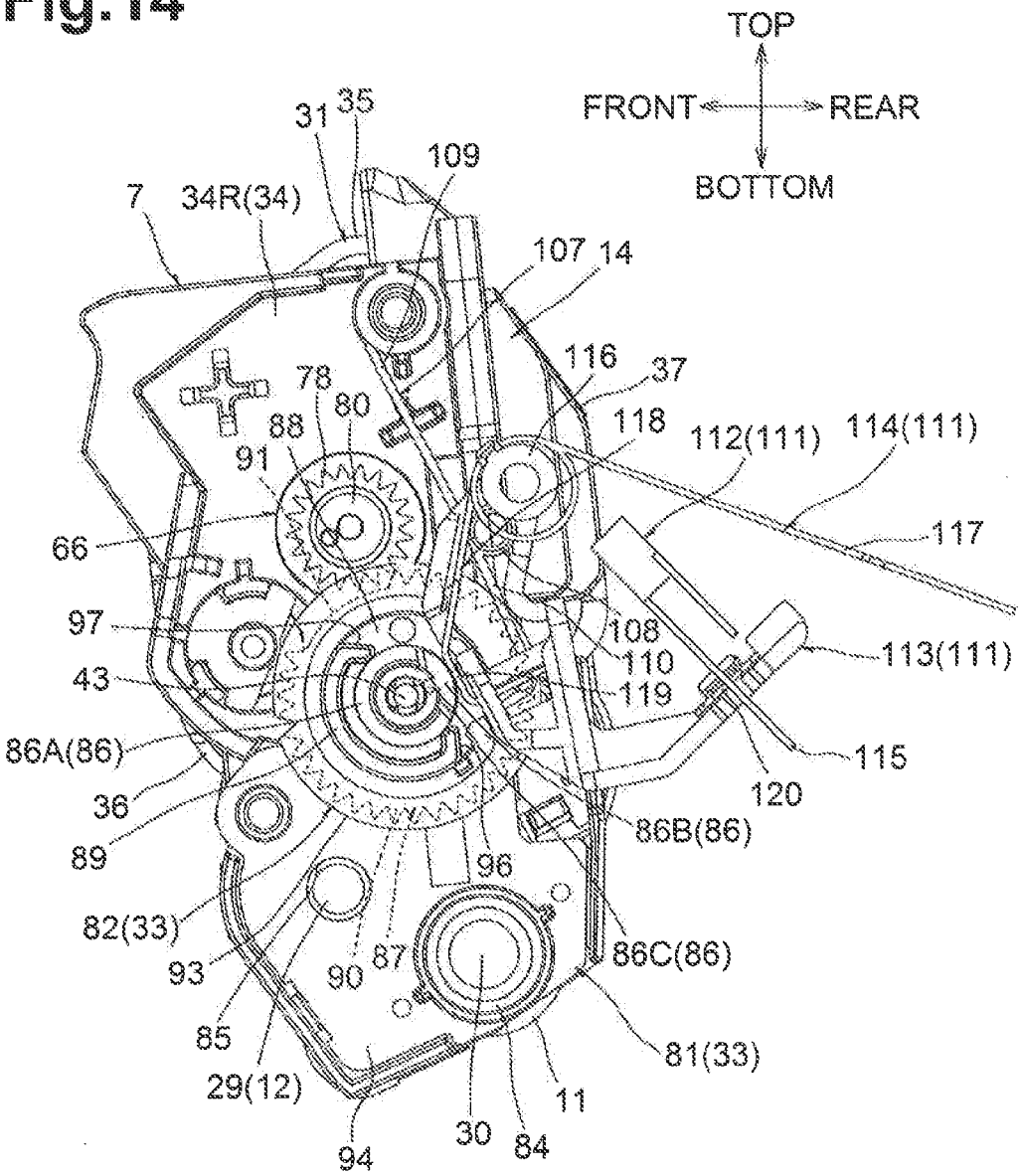
Fig.14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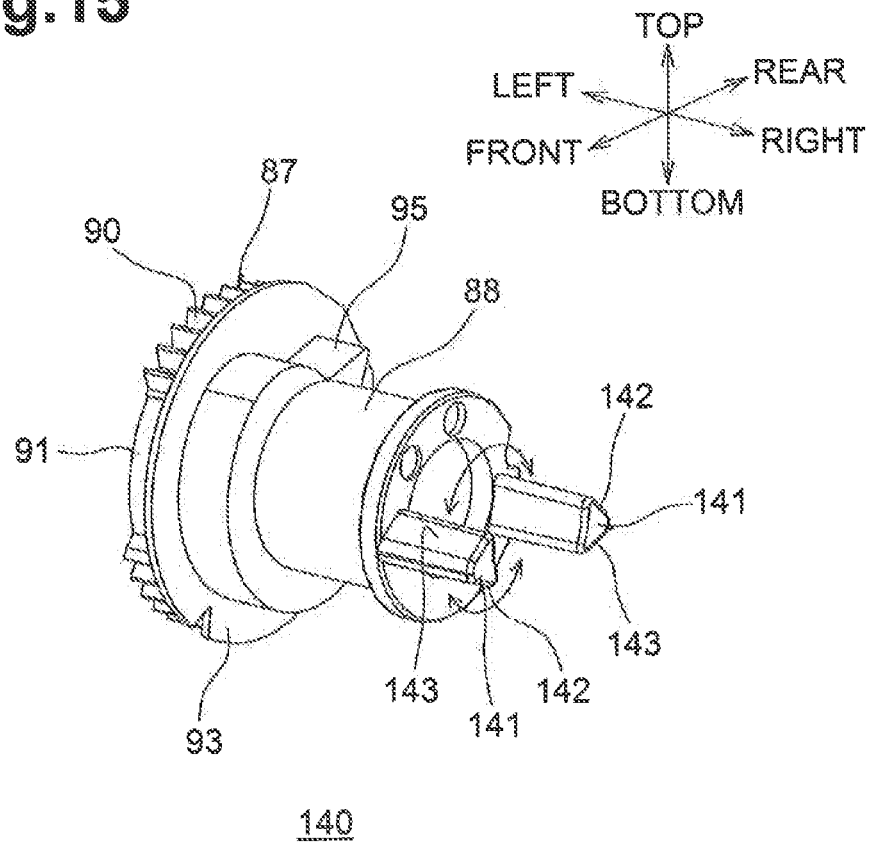
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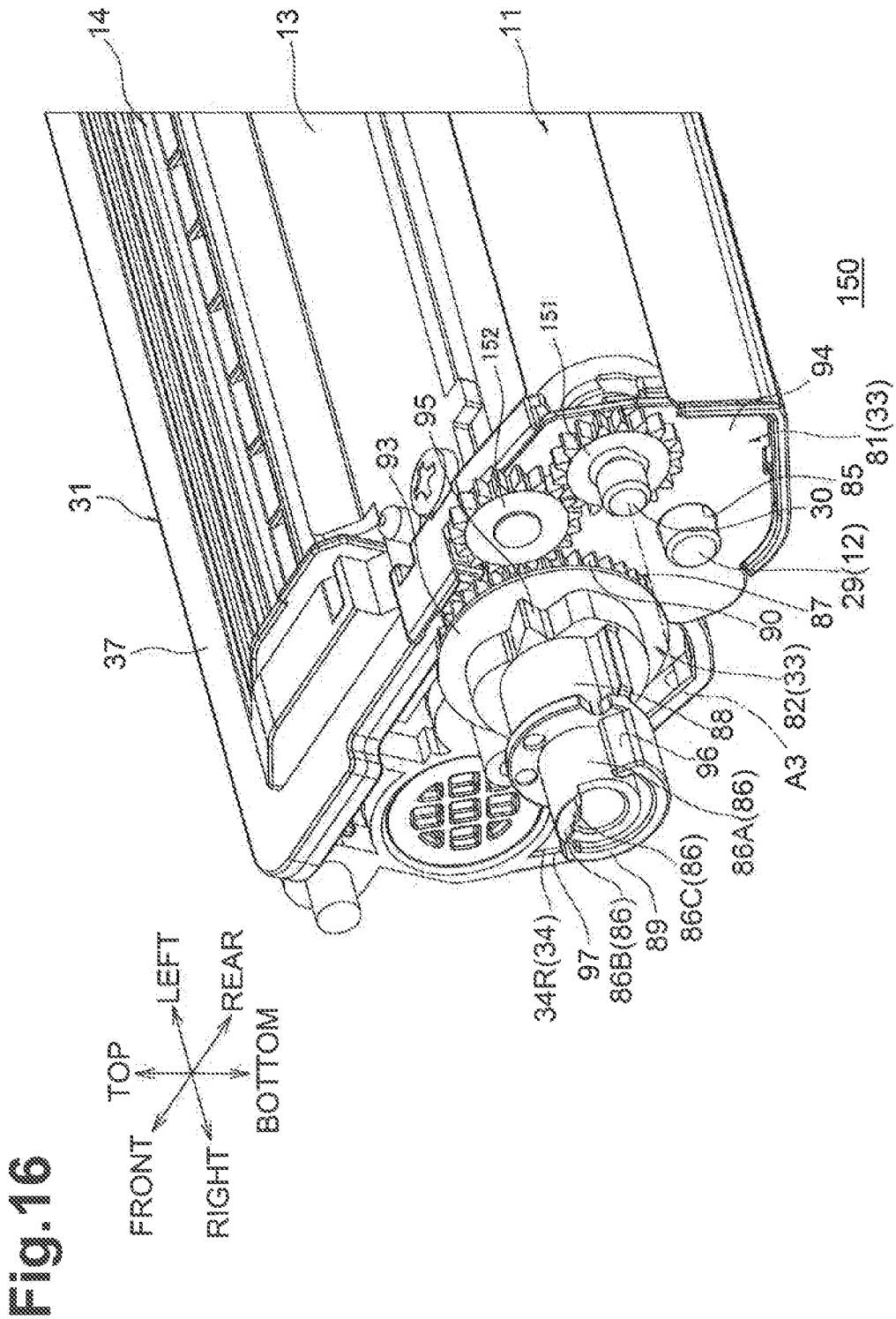
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Fig.16

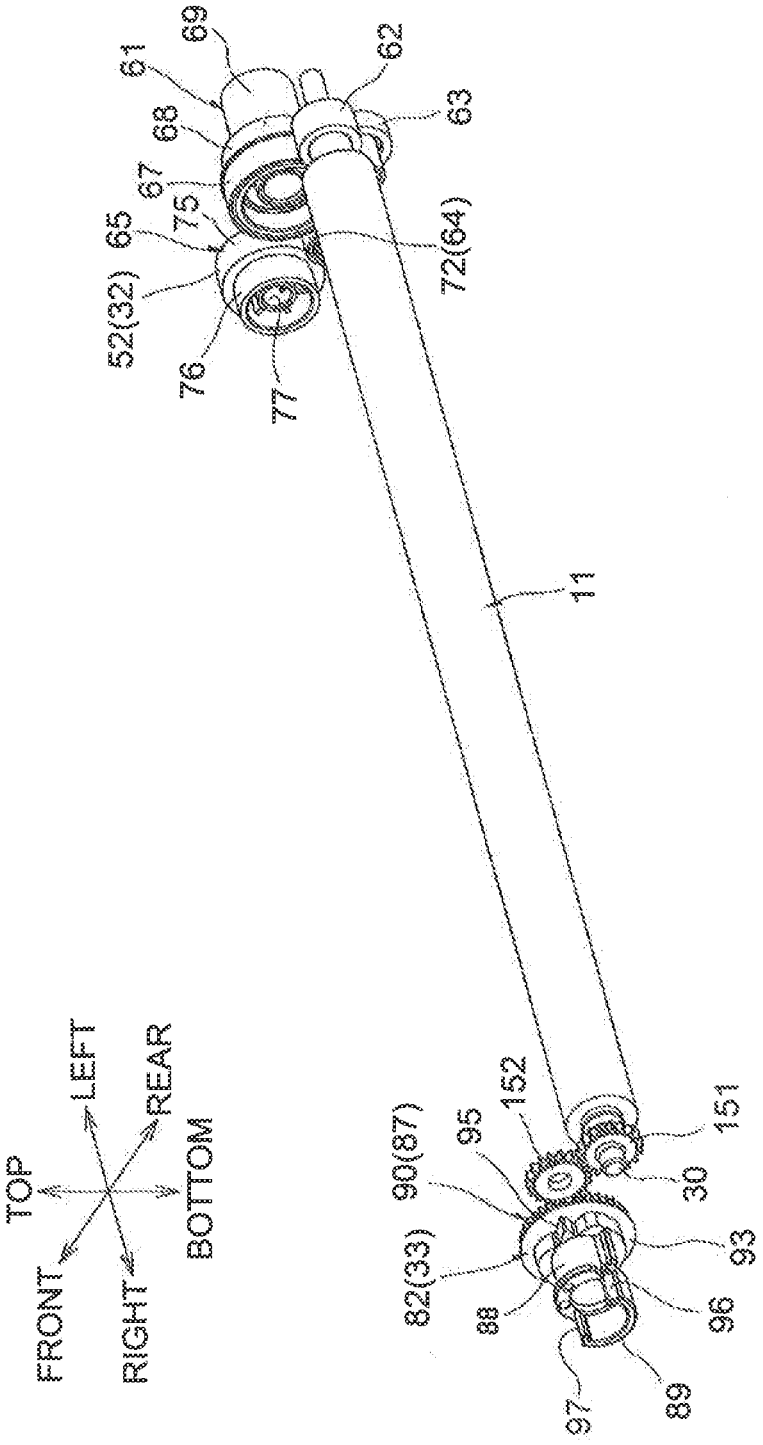
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Fig.17

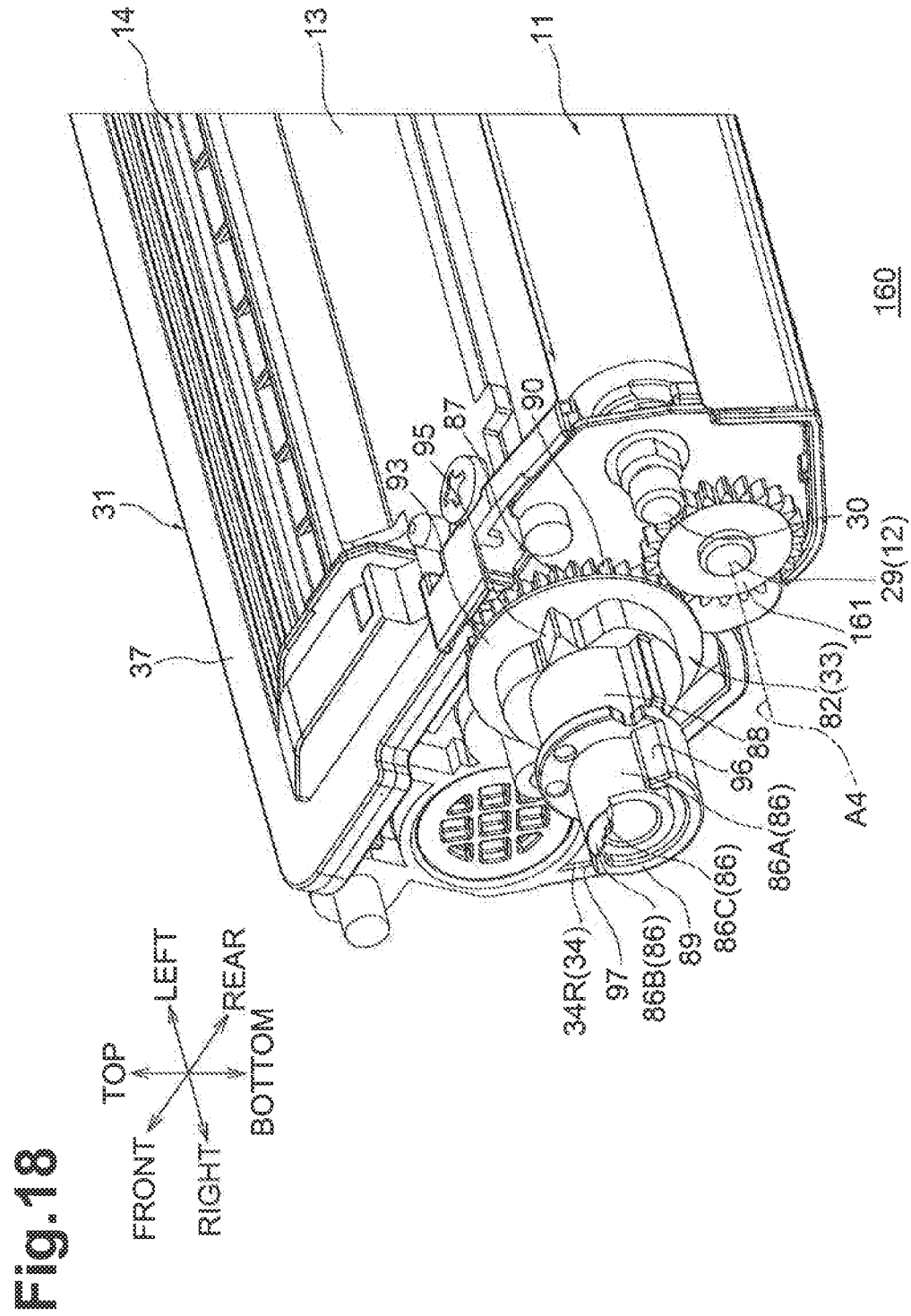
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Fig.18

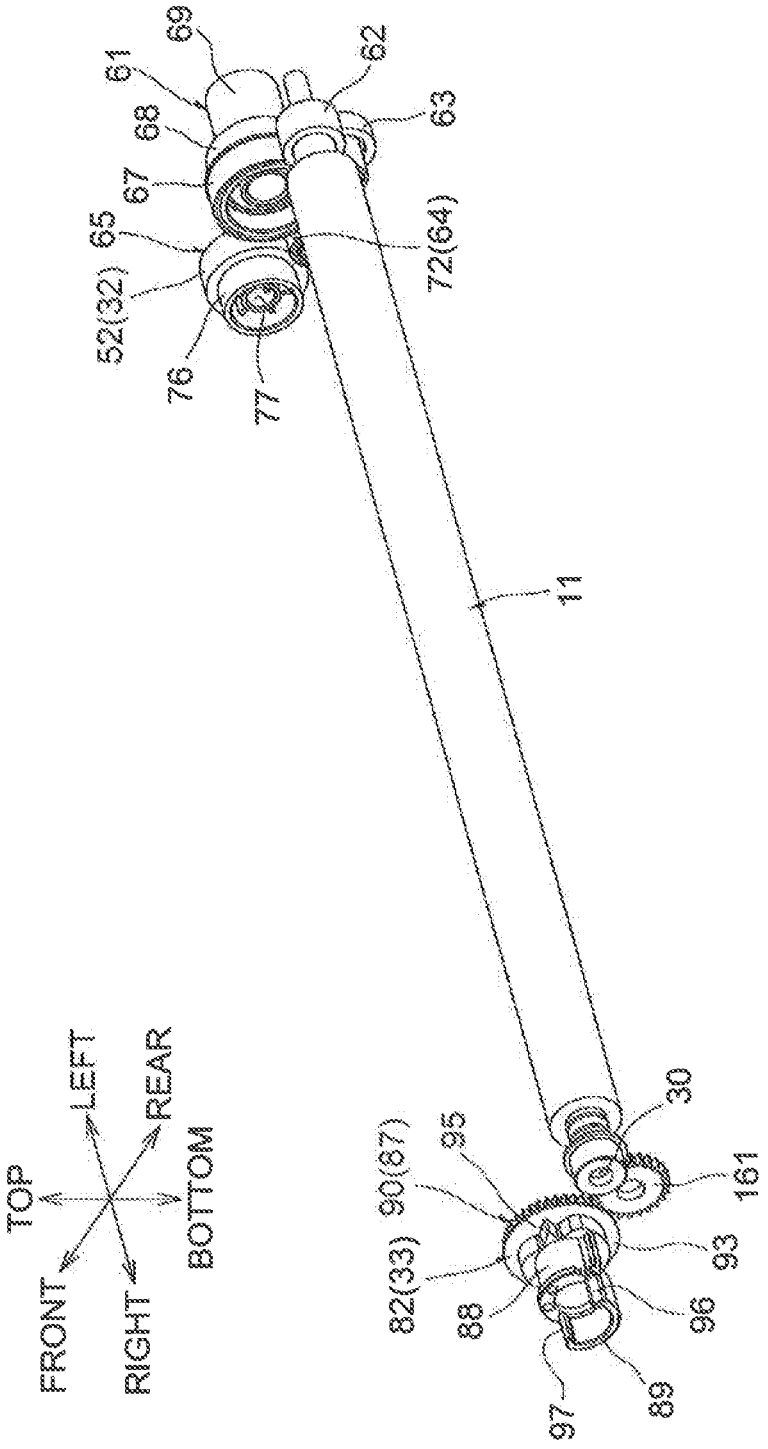
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Fig.19

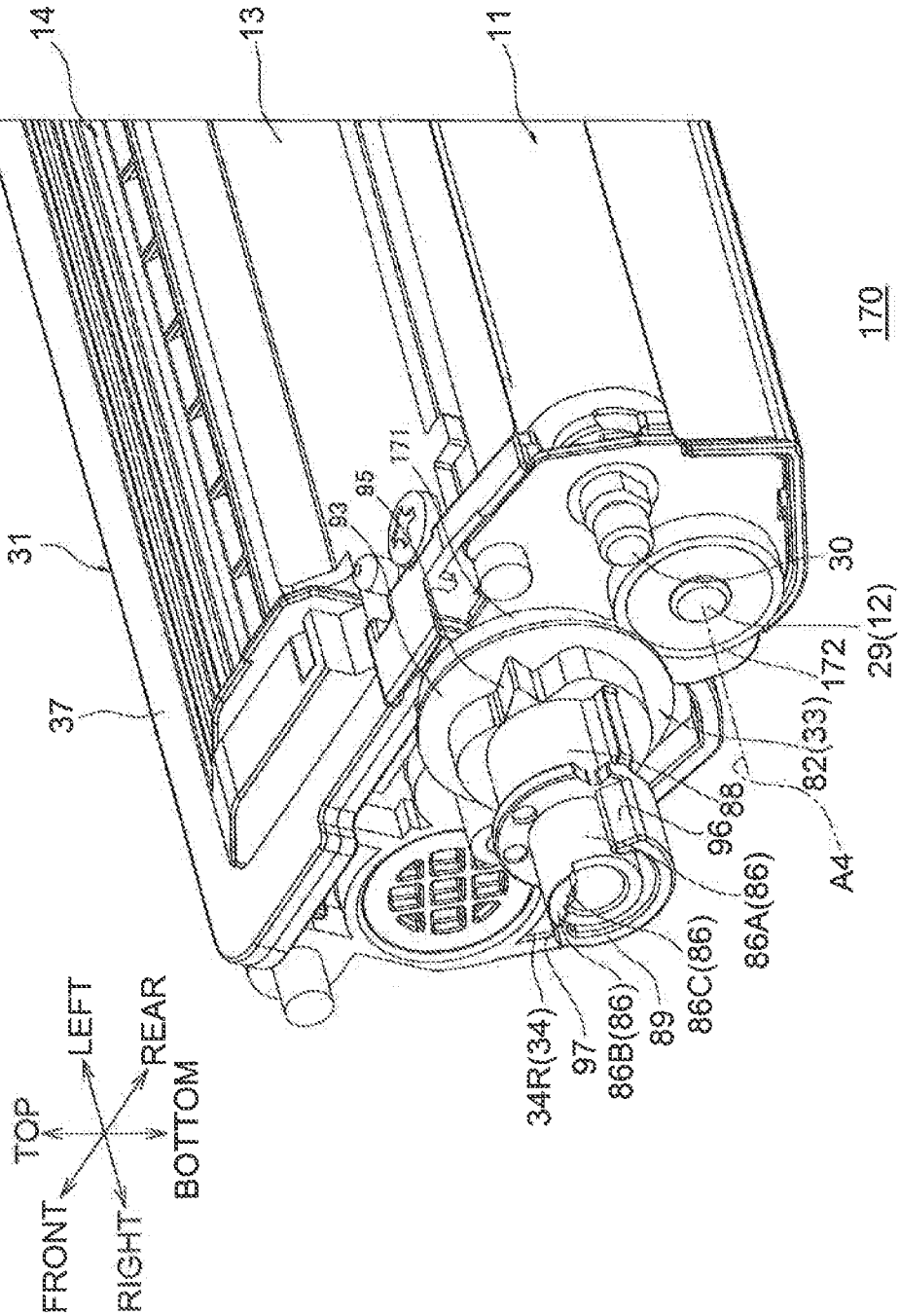
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Fig.20

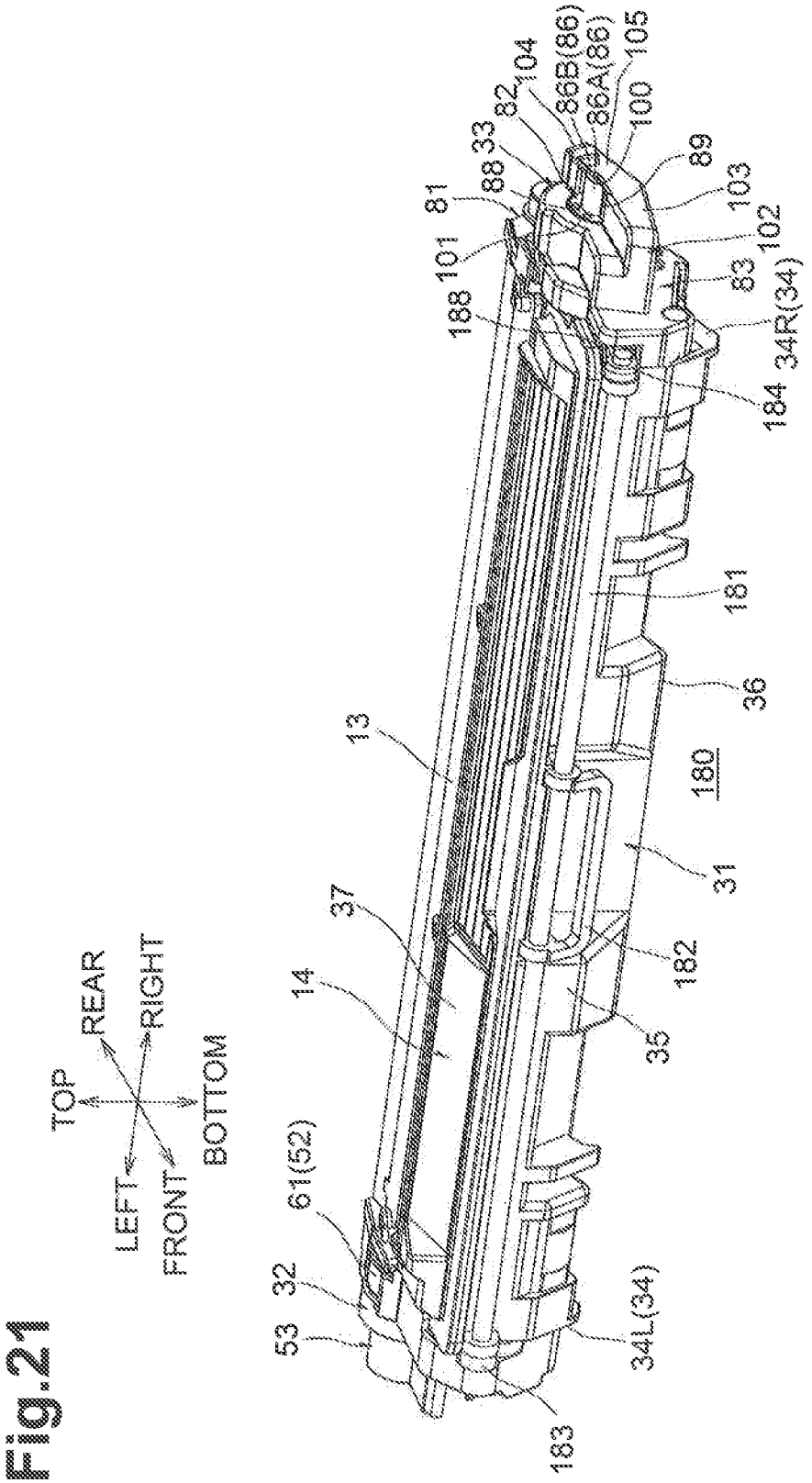
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Fig.21

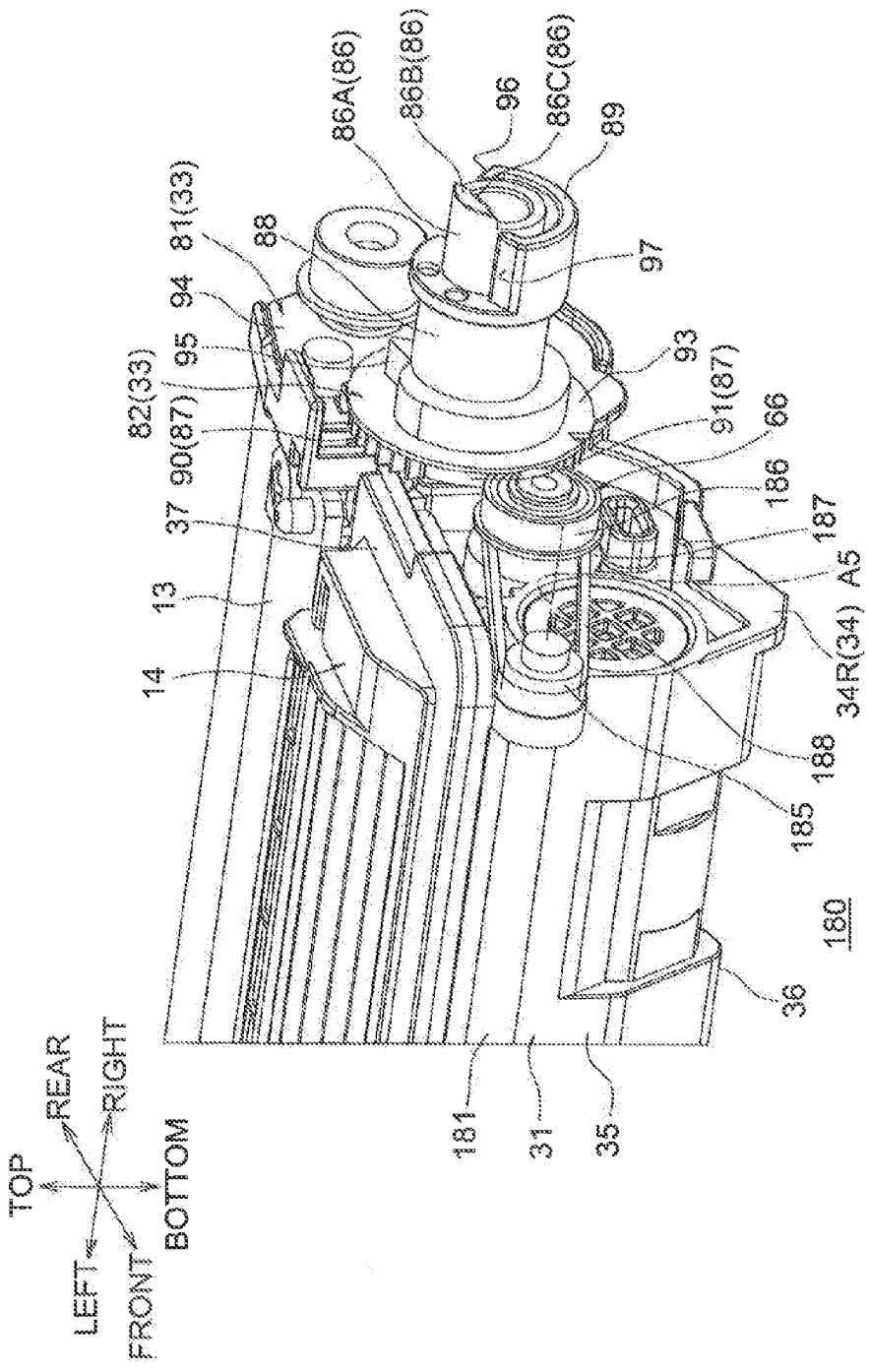
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Fig.22

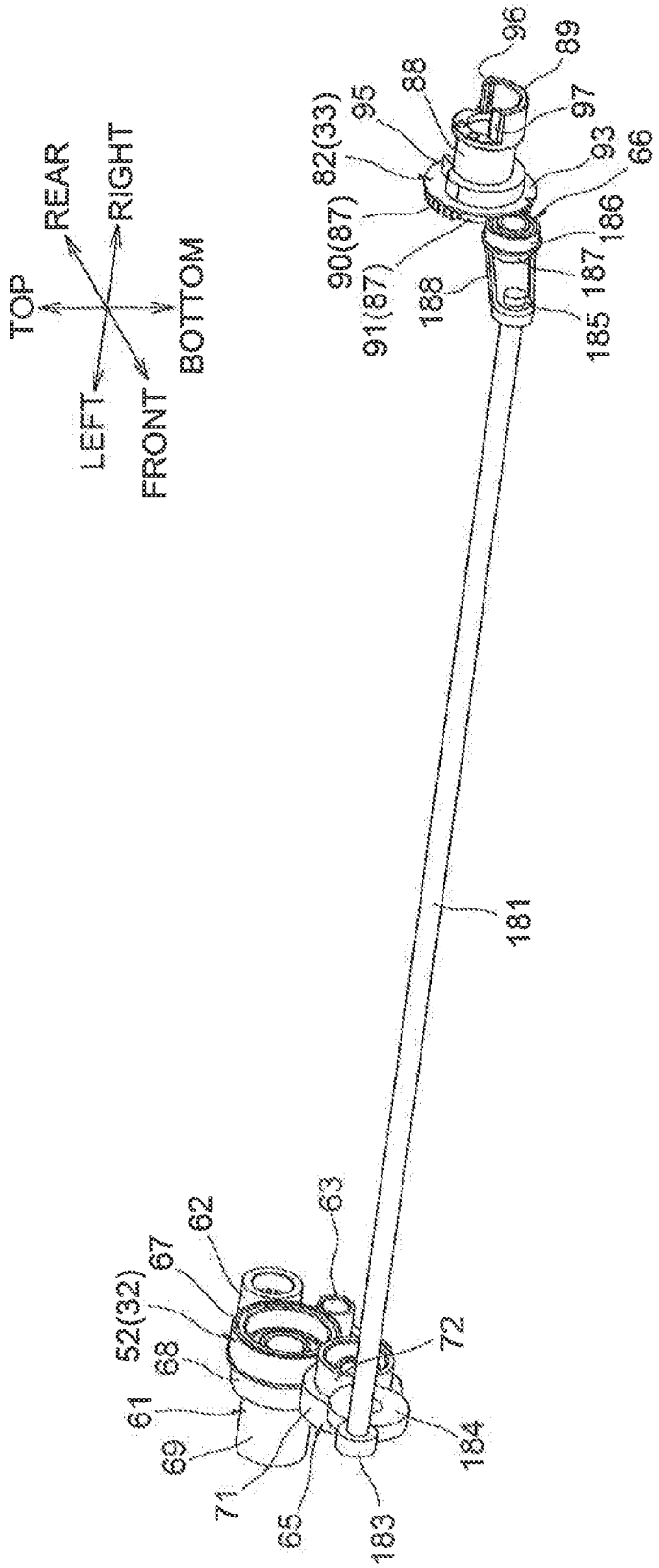
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Fig.23

CARTRIDGES INCLUDING DETECTION MEMBER AND COVER MEMBER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 14/032,259, filed on Sep. 20, 2013, which claims priority from Japanese Patent Application No. 2012-208910, filed on Sep. 21, 2012, the disclosures of which are incorporated herein by reference in their entirety.

BACKGROUND OF THE DISCLOSURE

1. Field of the Disclosure

The present disclosure relates generally to developing cartridges and, more specifically, to cartridges including a detection member and a cover member.

2. Description of the Related Art

Xerographic printers comprising a photosensitive member and a developing cartridge for supplying developer to the photosensitive member are known.

Such known printers include a detector for detecting information about the attached developing cartridge (e.g., whether the developing cartridge is new).

For example, a laser printer (e.g., a kind of xerographic printer) including a developing cartridge and a main body has been proposed. The main body of the laser printer includes a detector that includes an actuator and a light sensor, and the developing cartridge includes an abutting protrusion. When the developing cartridge is attached to the main body, the abutting protrusion is driven by the driving force supplied from the main body, moves, and contacts the actuator. When the abutting protrusion of the developing cartridge contacts the actuator of the main body, the actuator moves and the light sensor senses the movement of the actuator. The detector detects the information about the developing cartridge based on information sensed by the light sensor.

SUMMARY OF THE DISCLOSURE

Accordingly, it is an object of the present invention to provide a cartridge that may make the detection of the information of the cartridge easier.

Cartridges disclosed herein may include a developing roller, an electrode, a detection member, and a cover member. The developing roller may rotate about a first axis extending along a first direction. The electrode may electrically connect to the developing roller. The electrode may include a main body and a protrusion. The protrusion may protrude along the first direction from the main body to an end portion of the protrusion. The detection member may be rotatably supported on the protrusion. The detection member may include a cover portion, which may cover an exposable portion of the protrusion when the detection member is in a first rotational position. Moreover, the cover portion may expose the exposable portion of the protrusion when the detection member is in a second rotational position. The cover member may cover a portion of the detection member. Further, the cover member may form an opening therein, which may expose the cover portion of the detection member when the detection member is in the first rotational position. Moreover, the cover member may extend along the first direction to an end portion of the cover member. An overlap portion of the end portion of the protrusion may extend at least to the end portion of the cover member. Consequently, the overlap portion may overlap a portion of the end portion of the cover member in a second direction that is perpendicular to the first direction.

Cartridges disclosed herein may include a developing roller, an electrode, a detection member, and a cover member. The developing roller may rotate about a first axis extending along a first direction. The electrode may electrically connect to the developing roller. The electrode may include a main body and a protrusion. The protrusion may protrude along the first direction from the main body to an end portion of the protrusion. The detection member may be rotatably supported on the protrusion. The detection member may include a cover portion, which may cover a portion of the protrusion, and which may expose another portion of the protrusion. The cover member may form an opening, which may expose the cover portion of the detection member. Further, the cover member may cover another portion of the detection member. Moreover, the cover member may extend along the first direction to an end portion of the cover member. An overlap portion of the end portion of the protrusion may extend at least to the end portion of the cover member. Consequently, the overlap portion may overlap a portion of the end portion of the cover member in a second direction that is perpendicular to the first direction.

Cartridges disclosed herein may include a developing roller, an electrode, a detection member, and a cover member. The developing roller may rotate about a first axis extending along a first direction. The electrode may electrically connect to the developing roller. The electrode may include a main body and a protrusion. The protrusion may protrude along the first direction from the main body to an end portion of the protrusion. The detection member may be rotatably supported on the protrusion. The detection member may include a cover portion, which may cover a portion of the protrusion, and which may expose another portion of the protrusion. The cover member may form an opening, which may expose the other portion of the detection member. Further, the cover member may cover at least a portion of the cover portion. Moreover, the cover member may extend along the first direction to an end portion of the cover member. An overlap portion of the end portion of the protrusion may extend at least to the end portion of the cover member. Consequently, the overlap portion may overlap a portion of the end portion of the cover member in a second direction that is perpendicular to the first direction.

Other objects, features, and advantages will be apparent to persons of ordinary skill in the art from the following detailed description of the disclosure and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present disclosure, needs satisfied thereby, and the objects, features, and advantages thereof, reference now is made to the following descriptions taken in connection with the accompanying drawings.

FIG. **1** is a central cross-sectional diagram showing the printer to which the developing cartridge is attached.

FIG. **2** is a diagram showing a perspective view of the developing cartridge shown in FIG. **1**.

FIG. **3** is a diagram showing an exploded perspective view of a left end of the developing cartridge shown in FIG. **2**.

FIG. **4** is a diagram showing an exploded perspective view of a right end of the developing cartridge shown in FIG. **2**.

FIGS. **5**A and **5**B are diagrams showing the cartridge detection gear shown in FIG. **4**; FIG. **5**A is a diagram showing a perspective view of the cartridge detection gear; and FIG. **5**B is a diagram showing another perspective view of the cartridge detection gear.

FIG. **6** is a diagram showing a right side view of the developing cartridge shown in FIG. **2**. A cover is omitted from FIG. **6**.

FIGS. **7**A and **7**B are diagrams showing the developing cartridge shown in FIG. **2**; FIG. **7**A is a diagram showing a perspective view of the developing cartridge; and FIG. **7**B is a cross-sectional diagram of the developing cartridge along the line A-A shown in FIG. **7**A.

FIG. **8** is a diagram showing a perspective view of the electrode device.

FIG. **9** is a diagram illustrating a swinging of a swinging electrode that shows a state in which the swinging electrode is arranged in a lower released position and the developing cartridge is not attached to the casing.

FIG. **10** is a diagram illustrating the swinging of the swinging electrode that shows a state in which the swinging electrode is arranged in a connected position and the developing cartridge is attached to the casing.

FIG. **11** is a diagram illustrates a swinging of a swinging electrode that shows a state in which the swinging electrode is arranged in an upper released position and the developing cartridge is attached to the casing.

FIG. **12** is a diagram illustrating a new (e.g., unused, newly installed) cartridge detection operation for detecting the developing cartridge that shows that the swinging electrode of the casing electrode device makes contact with the power receiving portion of the developing cartridge immediately after the developing cartridge is attached to the casing.

FIG. **13** is a diagram illustrating the new cartridge detection operation for detecting the developing cartridge that shows that the swinging electrode of the casing electrode device is separated from the power receiving portion of the developing cartridge by pressure from the end portion of the new cartridge detection gear when a warm-up operation is started.

FIG. **14** is a diagram illustrating the new cartridge detection operation for detecting the developing cartridge that shows that the end portion of the new cartridge detection gear travels between the swinging electrode of the casing electrode device and the power receiving portion of the developing cartridge and that the swinging electrode of the casing electrode device is connected to the power receiving portion of the developing cartridge.

FIG. **15** is a diagram showing a perspective view of the new cartridge detection gear.

FIG. **16** is a diagram showing a perspective view of a power supply device for the developing cartridge.

FIG. **17** is a diagram illustrating a process of drive transfer through the developing cartridge that shows a drive system for the developing cartridge.

FIG. **18** is a diagram showing another perspective view of another power supply device for the developing cartridge.

FIG. **19** is a diagram illustrating another process of drive transfer through the developing cartridge that shows another drive system for the developing cartridge.

FIG. **20** is a diagram showing a perspective view of still another power supply device for the developing cartridge.

FIG. **21** is a diagram illustrating still another process of drive transfer through the developing cartridge that shows still another drive system for the developing cartridge.

FIG. **22** is a diagram showing a perspective view of yet another power supply device shown in the still another drive system in FIG. **21**.

FIG. **23** is a diagram illustrating yet another process of drive transfer through the developing cartridge.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

As shown in FIG. **1**, a printer **1** may be a tandem type of color printer. Further, the direction of printer **1** used herein utilizes a vertical reference defined as the vertical direction when the printer **1** lies in the right-left direction. Thus, the upper side of the plane of paper showing FIG. **1** may be referred to as the upper side, and the lower side of the plane of paper showing FIG. **1** may be referred to as the lower side. In addition, the left side of the plane of paper showing FIG. **1** may be referred to as the front side, and the right side of the plane of paper showing FIG. **1** may be referred to as the back side. Moreover, the right-left reference directions are defined as the right and left directions when facing the printer **1** from the front side with the upper side positioned above the lower side. Thus, the near side of the plane of paper showing FIG. **1** may be referred to as the right side, and the far side of the plane of paper depicting FIG. **1** may be referred to as the left side. Further, the right-left direction may refer to either or both of the right direction and the left direction (e.g., into or out of the page in FIG. **1**).

The printer **1** may comprise a casing **2** with substantially box shape. The casing **2** may form an opening **3** therein. The printer **1** may comprise a cover **4** that may be pivotally supported at an upper end portion of the casing **2**. The cover **4** may be configured to open and close the opening **3** of the casing **2**. The printer **1** may comprise a plurality (e.g., four) of process cartridges **5**.

Each of the process cartridges **5** may be detachably mounted in the casing **2** in a parallel arrangement separated from each other. Further, each of the plurality of process cartridges **5** may correspond to one color of multiple (e.g., four) colors (e.g., black, yellow, magenta, and cyan).

Each of the process cartridges **5** may comprise a drum cartridge **6** and a developing cartridge **7** detachably mounted to the drum cartridge **6**.

The drum cartridge **6** may comprise a photosensitive drum **8** and a scorotron charger **9**.

The photosensitive drum **8** may form a substantially cylindrical shape elongated in the right-left direction and may be rotatably supported at the rear end portion of the drum cartridge **6**.

The scorotron charger **9** may face the upper-rear side of the photosensitive drum **8**.

The developing cartridge **7** may comprise a developing roller **11** and a supply roller **12** that may be configured to supply toner to the developing roller **11**.

The developing roller **11** may be exposed from the rear side of the rear end of the developing cartridge **7** so that contact may be made with the photosensitive drum **8** from the upper-front side. The developing roller **11** may form a substantially cylindrical shape extending in the right-left direction. The developing roller **11** may comprise a metal-based rotating shaft (e.g., a developing roller shaft **30**) extending in the right-left direction along an axis of rotation **A1** thereof. The right and left ends of the developing roller shaft **30** may be rotatably supported by two side walls **34** (described below) of a cartridge frame **31** (described below).

The supply roller **12** may be disposed at the upper-front side of the developing roller **11** so as to make contact with

the developing roller **11**. The supply roller **12** may form a substantially cylindrical shape extending in the right-left direction. The supply roller **12** may comprise a metal-based rotating shaft (e.g., a supply roller shaft **29**) extending in the right-left direction along an axis of rotation thereof. The right and left ends of the supply roller shaft **29** may be rotatably supported by the two side walls **34** (described below) of the cartridge frame **31** (described below).

Further, the developing cartridge **7** may comprise a layer thickness regulating blade **13** that may be configured to regulate the thickness of the toner supplied on the developing roller **11**. In addition, the developing cartridge **7** may comprise a toner storage portion **14** that may be disposed on the upper side of the developing roller **11** and the supply roller **12** and may be configured to store the toner.

The toner storage portion **14** may comprise an agitator **15** that may be configured to agitate the toner.

The agitator **15** may comprise an agitator shaft **16** extending in the right-left direction and an agitator vane **17** extending from the agitator shaft **16** toward the interior circumference of the toner storage portion **14**, which may rotate around an axis of rotation A2 of the agitator shaft **16** (FIG. **3** provides an example of a second axis of rotation).

The toner in the toner storage portion **14** may be frictionally charged with a positive charge between the supply roller **12** and the developing roller **11**, and may be supported on the surface of the developing roller **11** by the layer thickness regulating blade **13** as a thin layer with a substantially uniform thickness.

In contrast, the surface of the photosensitive drum **8** may be uniformly charged by the scorotron charger **9** and subsequently exposed according to the predetermined image data by a light-emitting diode ("LED") device **10** facing the upper side of the photosensitive drum **8**. Consequently, an electrostatic latent image may be formed on the surface of the photosensitive drum **8**, based on the image data. Moreover, the toner supported on the developing roller **11** may be supplied onto the electrostatic latent image on the surface of the photosensitive drum **8**, and the toner image (e.g., developer image) may be supported on the surface of the photosensitive drum **8**.

A paper P may be stored in a paper feed tray **18** provided in the bottom of the casing **2**, transported by each roller toward the upper-rear side in a U-turn type of pattern, and subsequently fed between the photosensitive drum **8** and a transport belt **19**, one sheet at a time. Further, the paper P may be transported by the transport belt **19** between the photosensitive drums **8** and transfer rollers **20** from the front side to the rear side. At this time, the toner image may be transferred to the paper P.

In addition, the paper P may be heated and pressurized when passing between a heating roller **21** and a pressurizing roller **22**. At this time, the toner image may be heat-fused to the paper P.

Thereafter, the paper P may be transported to the upper-front side in a U-turn type of pattern and discharged to a discharge tray **23** provided in or around the top cover **4**.

As shown in FIG. **2**, the developing cartridge **7** may comprise a cartridge frame **31**, a drive device **32** that may be arranged at the left side of the cartridge frame **31**, and a power supply device **33** that may be arranged at the right side of the cartridge frame **31**.

Further, when referring to directions with regards to the following description of the developing cartridge **7**, the side where the developing roller **11** is arranged is referred to as the rear side of the developing cartridge **7**, and the side where the layer thickness regulating blade **13** is arranged is referred to as the upper side. Consequently, the vertical and front-rear directions related to the developing cartridge **7** may be different from the vertical and front-rear directions of the printer **1**, and the developing cartridge **7** may be attached in the printer **1**, such that the front of the developing cartridge **7** is the upper-front side of the printer **1**, the rear thereof is the lower-rear side of the printer **1**, the top side thereof is the upper-rear side of the printer **1**, and the bottom thereof is the lower-front side of the printer **1**.

The cartridge frame **31** may form a substantially box shape extending in the right-left direction. As shown in FIG. **3** and FIG. **4**, the cartridge frame **31** may comprise a pair of left and right side walls **34**, a front wall **35**, a lower wall **36**, and an upper wall **37**. Further, in the following description the left wall of the side walls **34** may be a left wall **34**L, and the right wall of the side walls **34** may be a right wall **34**R.

Each of the pair of side walls **34** may form a substantially rectangular shape from the side view and may face each other in the right-left direction. Further, each of the side walls **34** may form a developing roller shaft exposure hole **39** and a supply roller shaft exposure hole **38** and may comprise an agitator shaft supporting portion **40**.

The developing roller shaft exposure hole **39** may be formed as a through-hole forming a substantially U-shaped shape from the side view that may open toward the upper-rear side at the upper-rear end of each of the side walls **34**. The vertical length of the developing roller shaft exposure hole **39** may be longer than the diameter of the right and left end portions of the developing roller shaft **30**. In addition, the right and left ends of the developing roller shaft **30** may be exposed from the side walls **34** toward the outside of the cartridge frame **31** through the developing roller shaft exposure hole **39**.

The supply roller shaft exposure hole **38** may be a through-hole forming a substantially rectangular shape from the side view at the lower-front side of the developing roller shaft exposure hole **39**. The length of each edge of the supply roller shaft exposure hole **38** may be longer than the diameter of both the right and left ends of the supply roller shaft **29**. Further, the right and left ends of the supply roller shaft **29** may be exposed from the side walls **34** toward outside of the cartridge frame **31** through the supply roller shaft exposure hole **38**.

The agitator shaft supporting portion **40** may be formed at the upper-front side of the supply roller shaft exposure hole **38** and may form a substantially circular shape extending in the right-left direction so as to penetrate the side walls **34**. The inner diameter of the agitator shaft supporting portion **40** may be formed with a diameter larger than the diameter of both the right and left end portions of the agitator shaft **16**. Further, the right and left ends of the agitator shaft **16** may be exposed from the side walls **34** toward outside of the cartridge frame **31** through the agitator shaft supporting portion **40**. A seal member **41** (as shown in FIG. **4**) may be fitted inside the agitator shaft supporting portion **40**.

The seal member **41** may form a substantially cylindrical shape extending in the right-left direction and may comprise materials with elastic properties, such as a sponge. The outer diameter of the seal member **41** may be larger than the inner diameter of the agitator shaft supporting portion **40**. Further, an agitator shaft insertion hole **42** may be formed through the radial center of the seal member **41**.

The agitator shaft insertion hole **42** may form a substantially cylindrical shape from the side view with a diameter smaller than the outer diameter of the agitator shaft **16**.

Further, the seal member **41** may be fitted to left side of agitator shaft **16** and, at the same time, may press into the interior of the agitator shaft supporting portion **40**.

In addition, as shown in FIG. **6**, a fitting protrusion **43** may be provided at the right wall **34**R.

The fitting protrusion **43** may form a substantially cylindrical shape protruding from the right surface of the right wall **34**R in the right direction at the right-rear side of the agitator shaft supporting portion **40**.

The front wall **35** may be erected between front ends of the side walls **34**. The front wall **35** may form a substantially plate shape and may extend vertically (e.g., in the top-bottom direction) and in the right-left direction (e.g., into and out-of the paper in FIG. **6**).

The lower wall **36** may be erected in between the bottom ends of the side walls **34** and may connect to the lower end of the front wall **35**. The lower wall **36** may form a substantially plate shape and may extend in the front-rear direction and in the right-left direction.

The upper wall **37** may face an upper side of the front wall **35** and an upper side of each of the side walls **34**. The upper wall **37** may form a substantially plate shape extending in the front-rear direction and in the right-left direction. The edges of the upper wall **37** may be welded to the side walls **34** and the upper end of the front wall **35** at the periphery edges thereof.

As shown in FIG. **3**, the drive device **32** may comprise a bearing member **51**, a gear array **52**, and a drive side cover **53**.

The bearing member **51** may form a plate shape that may be a substantially rectangular shape in the side view. The bearing member **51** may form a developing roller shaft supporting hole **54** and a supply roller shaft supporting hole **55**. The bearing member **51** may comprise a coupling supporting shaft **56** and an idle gear supporting shaft **57**.

The developing roller shaft supporting hole **54** may be formed as a through-hole with a substantially circular shape in the side view from the upper end portion of the bearing member **51**. The inner diameter of the developing roller shaft supporting hole **54** may be formed as a diameter substantially the same size as or slightly larger than the outer diameter of the developing roller shaft **30**.

The supply roller shaft supporting hole **55** may be formed as a through-hole with a substantially circular shape from the side view from the lower-front side of the developing roller shaft supporting hole **54**. The inner diameter of the supply roller shaft supporting hole **55** may be formed as a diameter substantially the same size as or slightly larger than the outer diameter of the supply roller shaft **29**.

The coupling supporting shaft **56** may form a substantially cylindrical shape protruding from the left surface of the bearing member **51** toward the left side from the front side of the developing roller shaft supporting hole **54** and at the upper-front side of the supply roller shaft supporting hole **55**.

The idle gear supporting shaft **57** may form a substantially circular shape protruding from the left surface of the bearing member **51** toward the left side from the front end portion of the bearing member **51**.

The gear array **52** may comprise a coupling **61**, a developing gear **62**, a supply gear **63**, an idle gear **64**, a first agitator gear **65**, and a second agitator gear **66** (shown in FIG. **4**).

The coupling **61** may form a substantially cylindrical shape extending in the right-left direction. Further, the radial central portion of the coupling **61** may form a fitting hole with a diameter larger than or substantially the same as the outer diameter of the coupling supporting shaft **56**. The coupling **61** may comprise a large diameter gear portion **67**, a small diameter gear portion **68**, and a coupling portion **69**.

The large diameter gear portion **67** may be provided to the right end portion of the coupling **61**. The large diameter gear portion **67** may form a substantially disc shape with a thickness in the right-left direction. Gear teeth may be formed around the entire circumference of the large diameter gear portion **67**.

The small diameter gear portion **68** may form a substantially cylindrical shape protruding from the left surface of the large diameter gear portion **67** in the left direction. The outer diameter of the small diameter gear portion **68** may be smaller than the outer diameter of the large diameter gear portion **67**. The rotational axis of the small diameter gear portion **68** may line up with rotational axis of the large diameter gear portion **67**. Gear teeth may be formed around the entire circumference of the small diameter gear portion **68**.

The coupling portion **69** may form a substantially cylindrical shape protruding from the left surface of the small diameter gear **68** in the left direction. The outer diameter of the coupling portion **69** may be smaller than the outer diameter of the small diameter gear portion **68**. The rotational axis of the coupling portion **69** may line up with the rotational axis of the small diameter gear portion **68**. A connecting depression **70** may be formed at the left surface of the coupling portion **69**.

The connecting depression **70** may form a substantially elongated hole shape in the side view that extends radially to the coupling **61** so as to depress from the left surface of the coupling portion **69** in the right direction.

The developing gear **62** may form a substantially disc shape with a thickness in the right-left direction. A developing roller shaft fitting hole **73** may be formed at the radial center portion of the developing gear **62** so as to receive the left end portion of the developing roller shaft **30**. Gear teeth may be formed around the entire circumference of the developing gear **62**.

The supply gear **63** may form a substantially disc shape with a thickness in the right-left direction. A supply roller shaft fitting hole **74** may be formed at the radial center portion of the supply gear **63** so as to receive the left end of the supply roller shaft **29**. Gear teeth may be formed around the entire circumference of the supply gear **63**.

The idle gear **64** may form a substantially cylindrical shape extending in the right-left direction. The idle gear **64** may comprise a large diameter portion **71** and a small diameter portion **72** in an integrated manner.

The large diameter portion **71** may be provided at the left end portion of the idle gear **64** and may form a substantially disc shape with a thickness in the right-left direction. The outer diameter of the large diameter portion **71** may be smaller than the outer diameter of the small diameter gear portion **68** at the coupling portion **69**. Gear teeth may be formed around the entire circumference of the large diameter portion **71**.

The small diameter portion **72** may form a substantially cylindrical shape extending in the right-left direction so as to protrude from the right surface of the large diameter portion **71** in the right direction. The outer diameter of the small diameter portion **72** may be smaller than the outer diameter of the large diameter portion **71**. The small diameter portion **72** may share the same axis of rotation with the large diameter portion **71**. A fitting hole (not shown) may be formed in the radial center of the small diameter portion **72** as a through-hole that may receive the idle gear supporting

shaft **57**. Gear teeth may be formed around the entire circumference of the small diameter portion **72**.

The first agitator gear **65** may form a substantially cylindrical shape extending in the right-left direction. The first agitator gear **65** may comprise a gear portion **75** and a fitting cylinder portion **76**.

The gear portion **75** may form a substantially disc shape with a thickness in the right-left direction at the left end of the first agitator gear **65**. Gear teeth may be formed around the entire circumference of the gear portion **75**. An agitator shaft fitting hole **77** may be formed in the radial center of the gear portion **75** as a through-hole that may receive the left end of the agitator shaft **16**.

The fitting cylinder portion **76** may form a substantially cylindrical shape extending in the right-left direction so as to protrude from the right surface of the gear portion **75** in the right direction. The fitting cylinder portion **76** may share the same axis of rotation with the gear portion **75**. The inner diameter of the fitting cylinder portion **76** may be substantially the same size as or slightly larger than the diameter of the outer diameter of the agitator shaft supporting portion **40**.

As shown in FIG. **4**, the second agitator gear **66** may form a substantially cylindrical shape extending in the right-left direction. The second agitator gear **66** may comprise a gear portion **78**, a fitting cylinder portion **79**, and a collar portion **80**.

The gear portion **78** may form a substantially disc shape with a thickness in the right-left direction in a substantially center portion of the second agitator gear **66** along the right-left direction. Fewer gear teeth than those in the gear portion **75** of the first agitator gear **65** may be formed around the entire circumference the gear portion **78**. A fitting hole (not shown) may be formed at the radial center portion of the gear portion **78** as a through-hole to receive the right end of the agitator shaft **16**.

The fitting cylinder portion **79** may form a substantially cylindrical shape extending in the right-left direction so as to protrude from the left surface of the gear portion **78** in the right direction. The fitting cylinder portion **79** may share the same axis of rotation with the gear portion **78**. The outer diameter of the fitting cylinder portion **79** may be substantially the same size as or slightly smaller than the inner diameter of the agitator shaft supporting portion **40**.

The collar portion **80** may form a substantially cylindrical shape extending in the right-left direction with the right end portion closed so as to protrude from the right surface of the gear portion **78** in the right direction.

As shown in FIG. **3**, the drive side cover **53** may form a substantially tubular shape extending in the right-left direction with the left end closed. A collective size of the coupling **61**, the supply gear **63**, the idle gear **64**, and the first agitator gear **65** together may be a coverable size (e.g., in the front-rear direction and the vertical direction), over which the drive side cover **53** may fit to cover the coupling **61**, the supply gear **63**, the idle gear **64**, and the first agitator gear **65** together. Further, a coupling exposure opening **60** may be formed in the drive side cover **53**.

The coupling exposure opening **60** may be formed as a through-hole with a substantially circular shape in the side view at the left wall in substantially the front-rear center portion of the drive side cover **53** so as to expose the left surface of the coupling portion **69** of the coupling **61**.

The bearing member **51** may be installed to the left surface of the side wall **34**L so that the left end portion of the developing roller shaft **30** may be inserted into the developing roller shaft supporting hole **54** to enable rotation, and, at the same time, the left end of the supply roller shaft **29** may be inserted into the supply roller shaft supporting hole **55** to enable rotation.

This configuration may enable the left end portion of the developing roller shaft **30** to be supported in the developing roller shaft supporting hole **54** so as to rotate. Further, the left end portion of the supply roller shaft **29** may be supported in the supply roller shaft supporting hole **55** to enable rotation therebetween.

The coupling **61** may be supported in the coupling supporting shaft **56** of the bearing member **51** so as to enable relative rotation.

The developing gear **62** may be supported in the left end of the developing roller shaft **30**, such that relative rotation therebetween is prevented and the developing roller shaft **30** may be inserted into the developing roller shaft fitting hole **73**. The developing gear **62** may engage with the large diameter gear portion **67** in the coupling **61** from the rear.

The supply gear **63** may be supported on the left end portion of the supply roller shaft **29**, such that relative rotation therebetween is prevented and the supply roller shaft **29** may be inserted into the supply roller shaft fitting hole **74**. The supply gear **63** may engage with the small diameter gear portion **68** of the coupling **61** from the lower-rear.

The idle gear **64** may be supported on the idle gear supporting shaft **57** of the bearing member **51** to enable relative rotation therebetween. The large diameter portion **71** of the idle gear **64** may engage with the small diameter gear portion **68** of the coupling **61** from the lower-front side. Further, the small diameter portion **72** of the idle gear **64** may face the lower-front side of the large diameter gear portion **67** of the coupling **61** separated by a space.

The first agitator gear **65** may be installed on the left end of the agitator shaft **16**, such that relative rotation therebetween is prevented, and, at the same time, the fitting cylinder portion **76** thereof may be fitted to the agitator shaft supporting portion **40** to enable rotation. Thus, the first agitator gear **65** may rotate around the rotational axis A**1** of the agitator shaft **16**. The gear portion **75** in the first agitator gear **65** may engage with the small diameter portion **72** in the idle gear **64** from the front.

Further, the drive side cover **53** may permit exposure of the left surface of the coupling portion **69** of the coupling **61** through the coupling exposure opening **60**, and, at the same time, the coupling **61** (excluding the left surface of the coupling portion **69**), the supply gear **63**, the idle gear **64**, and the first agitator gear **65** may be screwed into the left wall **34**L so as to be collectively covered.

In addition, as shown in FIG. **4**, the second agitator gear **66** may be installed to the right end portion of the agitator shaft **16**, such that relative rotation therebetween is prevented, and, at the same time, the fitting cylinder portion **76** thereof may be fitted to the agitator shaft supporting portion **40** to enable rotation. Thus, the second agitator gear **66** may rotate around the axis of rotation A**1** of the agitator shaft **16**.

As shown in FIG. **4** and FIG. **6**, the power supply device **33** may comprise an electrode member **81**, a new cartridge detection gear **82**, and a cover **83**.

The electrode member **81** may be formed from plastic materials with electroconductive properties (e.g., conducting polymer materials, such as polyacetal plastic). The electrode member **81** may comprise a casing **94**, a developing roller shaft supporting portion **84**, a supply roller shaft supporting portion **85** (shown in FIG. **6**), and a power receiving portion **86**.

The casing **94** may form a plate shape that may be substantially rectangular from the side view.

The developing roller shaft supporting portion **84** may form a substantially cylindrical shape extending in the right-left direction at the upper-rear end of the casing **94** so as to penetrate the casing **94**. The inner diameter of the developing roller shaft supporting portion **84** may be formed to be substantially the same size as or slightly larger than the outer diameter of the right end of the developing roller shaft **30**.

The supply roller shaft supporting portion **85** may form a substantially circular shape in the side view at the lower-front side of the developing roller shaft supporting portion **84** so as to penetrate the casing **94**. The inner diameter of the supply roller shaft supporting portion **85** may be formed to be substantially the same size as or slightly larger than the outer diameter of the supply roller shaft **29**.

The power receiving portion **86** may be disposed at the upper-front side of the supply roller shaft supporting portion **85**. The power receiving portion **86** may comprise a main body **86**A, an extending portion **86**B, and a rib **86**C.

The main body **86**A may form a substantially cylindrical shape extending from the front end portion of the casing **94** toward the right side so as to penetrate the casing **94**.

The extending portion **86**B may protrude from the right end face of the upper end portion of the main body **86**A in the right direction and may be formed as a protrusion with a substantially arc shape extending in the front-rear direction along the circumference of the main body **86**A in the side view. The front end portion of the extending portion **86**B may be chamfered to slant in the left direction and downward. The read end of the extending portion **86**B may be chamfered to slant in the right direction, the rear direction, and downward. Further, a right surface **86**E of the extending portion **86**B may be formed as a plane extending in the vertical direction in the front rear direction.

The rib **86**C may be formed in the interior of the extending portion **86**B in a substantially center portion of the main body **86**A along the front-rear direction (e.g., the radial extension direction of the main body **86**A). The rib **86**C may protrude from the main body **86**A and interior surface of the extending portion **86**B toward the interior side and may be formed as a protrusion extending in the right-left direction. The right end of the rib **86**C may be chamfered to slant in the left direction and downward.

As shown in FIG. **4** and FIGS. **5**A and **5**B, a cartridge detection gear **82** may be formed from plastic materials with insulating properties (e.g., polyacetal plastic) with a substantially cylindrical shape extending in the right-left direction.

Further, the new cartridge detection gear **82** may comprise a sector gear **87**, a cylinder portion **88**, and an end portion **89** in an integrated manner.

The sector gear **87** may form a substantially disc shape with a thickness in the right-left direction. Gear teeth may be formed around a portion of the circumference of the sector gear **87** substantially equal to a center angle of 315°. Thus, the circumference of the sector gear **87** may comprise a teeth portion **90**, which may be formed with gear teeth, and toothless portion **91**, which may be formed without gear teeth.

Further, the radial center portion of the sector gear **87** may form a power receiving portion insertion hole **92**.

The power receiving portion insertion hole **92** may form a substantially circular form in the side view and may share the same axis of rotation with the sector gear **87**. The diameter of the power receiving portion insertion hole **92** may be larger than the outer diameter of the power receiving portion **86** in the electrode member **81**.

The cylinder portion **88** may protrude from the outer edge portion of the power receiving portion insertion hole **92** of the sector gear **87** in the right direction and may form a substantially cylindrical shape that may share the same rotational axis with the sector gear **87**. The inner diameter of the cylinder portion **88** may be substantially the same size as the diameter of the power receiving portion insertion hole **92**. The cylinder portion **88** may comprise a flange portion **93** and a bias portion **95** (shown in FIG. **4**).

The flange portion **93** may be formed as a protrusion extending around the cylinder portion **88** and may protrude outward in the radial direction from the exterior surface of the cylinder portion **88** at the left end portion of the cylinder portion **88**.

The bias portion **95** may be formed as a protrusion with a substantially wedge shape protruding outwards in the radial direction from the exterior surface of the cylinder portion **88** (shown in FIGS. **7**A and **7**B) at the right side of the flange portion **93**.

The end portion **89** may be formed with a partial cylindrical shape with a center angle of about 120° and may extend from the right end portion of the cylinder portion **88** in the right direction.

Further, the downstream edge of the end portion **89** in a clockwise direction in the right view may be formed with a downward slanting face **97** (e.g., in a bottom-front direction as shown in FIG. **4**), which may slant toward the outside, extend in the radial direction, and run in a clockwise direction upward in the right view. In addition, the upstream edge of the end portion **89** in a clockwise direction in the right view may be formed with an upward slanting face **96** (e.g., in a top-front direction as shown in FIG. **4**), which may slant toward the inside, extend in the radial direction, and run in a clockwise direction upward in the right view.

As shown in FIG. **4** and FIG. **7**A, the cover **83** may form a substantially tubular shape extending in the right-left direction and with a right end that may be closed. The cover **83** may be formed such that the cover **83** may cover both a new cartridge detection gear **82** and a second agitator gear **66** (e.g., may be appropriately large in both the front-rear direction and vertical direction). Further, the cover **83** may comprise a power receiving portion exposure opening **101** and a power receiving portion protecting portion **102**.

The power receiving portion exposure opening **101** may be formed as a through-hole with a substantially circular shape at the right wall of a substantially center portion of the cover **83** along the right-left direction so as to expose the end portion **89** in the new cartridge detection gear **82**.

The power receiving portion protecting portion **102** may comprise a first protecting portion **103** that may cover a portion of the power receiving portion **86** at the front side thereof, a second protecting portion **104** that may cover a portion of the power receiving portion **86** at the rear side thereof, and a third protecting portion **105** that may cover a portion of the power receiving portion **86** at the right side thereof.

The first protecting portion **103** may form a substantially prismatic shape protruding from the front edge of the power receiving portion exposure opening **101** in the right direction.

The second protecting portion **104** may form a substantially prismatic shape protruding from the rear edge of the power receiving portion exposure opening in the right direction.

The third protecting portion **105** may form a substantially plate shape extending in the right-left direction and may be disposed between the right end portion of the first protecting portion **103** and the right end portion of the second protecting portion **104**. An upper edge **100** of the third protecting portion **105** may form a substantially V-shaped shape in the side view. Specifically, the upper edge **100** of the third protecting portion **105** may connect to the rear side of the top edge of the first protecting portion **103** and extend toward the front side, may curve around the right side of a substantially center portion of the power receiving portion exposure opening **101** along the front-rear direction and toward the top, and may connect to the upper edge on the front side of the second protecting portion **104**. Further, a right surface **105**A of the third protecting portion **105** may be formed as a plane surface extending in the vertical direction and the front-rear direction. In addition, the third protecting portion **105** may comprise a fitting portion **106**.

The fitting portion **106** may be arranged at the right side of a substantially center portion of the power receiving portion exposure opening **101** along the front-rear direction. The fitting portion **106** may form a substantially cylindrical shape protruding from the left surface of the third protecting portion **105** in the left direction. The upper end of the fitting portion **106** may form a substantially V-shaped shape in the side view and may follow along the upper edge of the third protecting portion **105**. The outer diameter of the fitting portion **106** may be substantially the same size as or slightly smaller than the inner diameter of the power receiving portion **86**.

As shown in FIG. **4** and FIG. **6**, the electrode member **81** may be installed to the right side of the right wall **34**R so that the right end portion of the developing roller shaft **30** may be inserted into the developing roller shaft supporting portion **84** to enable rotation thereof, and the right end portion of the supply roller shaft **29** may be inserted into the supply roller shaft supporting portion **85** to enable rotation thereof.

Consequently, the right end portion of the developing roller shaft **30** may be rotatably supported in the developing roller shaft supporting portion **84**. Further, the right end of the supply roller shaft **29** may be rotatably supported in the supply roller shaft supporting portion **85**.

Also, the upper-rear end portion of the power receiving portion **86** may be arranged to overlap the coupling **61** when projected in the right-left direction (shown in FIG. **4**).

The new cartridge detection gear **82** may be fitted to the power receiving portion **86** of the electrode member **81** to enable rotation thereof. Consequently, the lower half of the right end portion of the power receiving portion **86** may be covered at the bottom by the end portion **89**. Further, the upper half of the right end of the power receiving portion **86** may be exposed from the downward slanting face **97** to the upward slanting face **96**. Thus, the space between the downward slanting face **97** and the upward slanting face **96** may be a first exposed portion **98** that may expose the power receiving portion **86** (shown in FIGS. **5**A and **5**B).

Further, the upper end portion of the new cartridge detection gear **82** may be arranged to overlap the coupling **61** when projected in the right-left direction (shown in FIG. **4**).

Further, the new cartridge detection gear **82** may be biased in a clockwise (e.g., in the right side view) manner by a torsion coil spring **107**. Specifically, the torsion coil spring **107** may be formed from a metal, and may comprise a coil portion **108**, a fixed end portion **109**, and a bias end portion **110**. The coil portion **108** may form a helix shape that may wrap around clockwise (e.g., in the right side view) and may travel from the right side toward the left side. The fixed end portion **109** may form a substantially straight line shape that may connect at the left end of the coil portion **108** and may extend in the front direction. The bias end portion **110** may form a substantially L-shaped shape that may connect at the right end of the coil portion **108**, may extend toward the rear side, and may curve around the rear end thereof in the downward direction.

Further, the torsion coil spring **107** may be supported in the cover **83** by the coil portion **108**, and, at the same time, may be fixed to the upper-front end of the right wall **34**R by the fixed end portion **109**. In addition, the bias end portion **110** may abut the bias portion **95** in the new cartridge detection gear **82** from the upper-front side.

Consequently, the new cartridge detection gear **82** may abut around clockwise (e.g., in the right side view), and the end portion of the blade member **90** in the sector gear **87**, which rotates downward in a clockwise manner in the right side view, may engage with the second agitator gear **66** from the front.

Further, as shown in FIG. **7**A, the cover **83** permits the power receiving portion **86** to protrude through the power receiving portion exposure opening **101** therein, and, at the same time, the right wall **34**R may be screwed down to collectively cover the new cartridge detection gear **82** and the second agitator gear **66**.

At this time, the fitting portion **106** of the cover **83** may fit into the right end portion of the power receiving portion **86** at the lower side of the rib **86**C. Consequently, the right end portion of the power receiving portion **86** may be covered from the right side by the third protecting portion **105** regarding the portion below the extending portion **86**B and the rib **86**C. Thus, at the right end portion of the power receiving portion **86**, the portion excluding the extending portion **86**B and the rib **86**C may be covered by the third protecting portion **105** and may be denoted as a second covered portion **86**D (shown in FIG. **4**).

Further, as shown in FIG. **7**B, the extending portion **86**B of the power receiving portion **86** may engage with the upper edge **100** of the third protecting portion **105** of the cover **83** from the top side so that the right surface **86**E thereof may be substantially flush with the a right surface **105**A of the third protecting portion **105**. Thus, the extending portion **86**B of the power receiving portion **86** may be arranged to overlap the third protecting portion **105** of the cover **83** when projected vertically. Further, the right surface **86**E of the extending portion **86**B of the power receiving portion **86** may be arranged to overlap the right surface **105**A of the third protecting portion **105** of the cover **83** when projected vertically. Consequently, the right surface **86**E of the extending portion **86**B may be exposed toward the right side at the upper side of the upper edge **100** of the third protecting portion **105**.

As shown in FIG. **8** and FIG. **9**, the casing may comprise an electrode device **111** configured to supply developer bias to the developing cartridge **7** within the casing **2**.

The electrode device **111** may comprise a fixed electrode **112**, a holder member **113**, and a swinging electrode **114**.

The fixed electrode **112** may be a coil spring formed of metal, and a portion thereof may be fixed near the right side of the developing cartridge **7** within the casing **2**.

The holder member **113** may be disposed at the left side of the fixed electrode **112**. The holder member **113** may be formed from plastic materials with insulating properties and may form a substantially curved shaft shape, which may be substantially U-shaped, extending in the front-rear direction where the upper-rear side opens. The upper end of the holder

member **113** may comprise a tubular portion **116** that may form a substantially cylindrical shape extending in the right-left direction, and the tubular portion **116** may be rotatably fitted onto a swinging shaft (not shown) within the casing **2**.

The swinging electrode **114** may be a coil spring formed of metal that may wrap around the tubular portion **116**, and a portion thereof may be a fixed portion **117** that may be fixed near the right side of the developing cartridge **7** within the casing **2**; and another portion thereof may be an electrode portion **118** fixed to the holder member **113**.

The electrode portion **118** may comprise a developer side contact **119** that may contact the power receiving portion **86** of the developing cartridge **7**, and a casing side contact **120** that may contact with the free end of the fixed electrode **112**. The developer side contact **119** may be supported at the front end portion of the holder member **113** and may be exposed to the lower-front side. The casing side contact **120** may be supported at the lower-rear end portion of the holder member **113** so as to be disposed at the left side of a free end portion **115** of the fixed electrode **112** and may be exposed to the right side.

Further, as shown in FIG. **9**, the swinging electrode **114** may be normally held in a lower separated position, due to the elastic properties thereof, so that the casing side contact **120** may be separated from the free end **115** in the fixed electrode **112**.

Moreover, as shown in FIG. **10**, the swinging electrode **114** may swing counter-clockwise from the right view against this elastic force by being pushed from the front side, and the casing side contact **120** may be disposed at a connected position and may contact with the free end portion **115** of the fixed electrode **112**.

In addition, as shown in FIG. **11**, the swinging electrode **114** may swing counter-clockwise from the right view against this elastic force by being further pushed from the front, and the casing side contact **120** may be disposed at an upper separated position separated from the free end **115** of the fixed electrode **112**.

Further, as shown in FIG. **8**, a power supply **131**, a bias detection device **132**, and a central processing unit ("CPU") **133** may be provided within the casing **2**.

The power supply **131** may be electrically connected to the fixed portion **117** of the swinging electrode **114**. The power supply **131** may supply developer bias to the swinging electrode **114**.

The bias detection device **132** may be electrically connected to the fixed electrode **112**. The bias detection device **132** may detect the developer bias supplied from the power supply **131** to the fixed electrode **112** through the swinging electrode **114**.

The CPU **133** may be electrically connected to the bias detection device **132**. The CPU **133** may determine the state of the developing cartridge **7** on the basis of the detection of whether the developer bias has been supplied to the fixed electrode **112** via the bias detection device **132**. When there is a detection that the developer bias has been supplied to the fixed electrode **112** from the power supply **131** by the bias detection device **132**, the CPU **133** may determine that the swinging electrode **114** is disposed at the connected position. Further, when there is no detection that the developer bias has been supplied to the fixed electrode **112** from the power supply **131** by the bias detection device **132**, the CPU **133** may determine that the swinging electrode **114** is disposed at the lower separated position or the upper separated position.

The new cartridge detection operation of the developing cartridge **7** now is described with reference to FIGS. **8** through **14**.

As shown in FIG. **9**, when the process cartridges **5** are not attached within the casing **2**, the swinging electrode **114** may be held at the lower separated position.

At this time, the developing cartridge **7** may not be attached within the casing **2**, so the developer bias may not be supplied from the cartridge frame **31** to the developing cartridge **7** and the fixed electrode **112**, and the bias detection device **132** may not detect that the developer bias has been supplied from the power supply **131** to the fixed electrode **112**. Consequently, the CPU **133** may determine that the developer bias has not been supplied to the fixed electrode **112**.

Thus, when the bias detection device **132** does not detect that the developer bias has been supplied to the fixed electrode **112** after a predetermined amount of time, the CPU **133** may determine that the developing cartridge **7** has been removed from the casing **2**.

Further, when the top cover **4** of the casing **2** is opened, and a process cartridge **5** with a new (e.g., unused) developing cartridge **7** attached thereto is inserted into the casing **2** from the upper-front side, the power receiving portion **86** in the developing cartridge **7** may abut with the holder member **113** from the upper-front side.

In addition, when the developing cartridge **7** is further inserted into the casing **2**, pressure may be applied to the holder member **113** by the power receiving portion **86** in the developing cartridge **7**, and the electrode portion **118** of the swinging electrode **114** may swing counter-clockwise from the right side view together with the holder member **113**.

Moreover, as shown in FIG. **10** and FIG. **12**, subsequent to attaching the developing cartridge **7** into the casing **2**, the developer side contact **119** on the swinging electrode **114** may contact the power receiving portion **86** of the developing cartridge **7** through the space between the downward slanting face **97** and the upward slanting face **96** of the end portion **89** from the rear side. In addition, the swinging electrode **114** may be arranged in the connected position, and the casing side contact **120** may make contact with the free end **115** of the fixed electrode **112**. Further, the downward slanting face **97** on the end portion **89** may be arranged to the front side of the holder member **113** and the swinging electrode **114**.

As a result, the developer bias supplied from the power supply **131** to the swinging electrode **114** may be supplied to the power receiving portion **86** of the developing cartridge **7** through the developer side contact **119**.

The developer bias supplied to the power receiving portion **86** of the developing cartridge **7** may be applied to the developing roller shaft **30** through the electrode member **81**.

Further, the developer bias supplied to the swinging electrode **114** may be supplied from the casing side contact **120** to the fixed electrode **112** through the free end **115** in the fixed electrode **112**, and subsequently may be detected by the bias detection device **132**.

Thus, the CPU **133** may determine the developer bias has been supplied to the fixed electrode **112**.

In contrast, as shown in FIG. **2**, when the developing cartridge **7** is attached to the casing **2**, the front end of a casing coupling **121** of the casing **2** may be inserted into the connecting depression **70** of the coupling **61**, which may prevent relative rotation therebetween. Thus, drive power may be input to the coupling **61** from the casing **2** via the casing coupling **121**, and the warm-up operation may start.

Thus, as shown in FIG. **3**, the drive power may be transferred from the coupling **61** to the agitator shaft **16** through the idle gear **64** and the first agitator gear **65**, and the agitator **15** may be rotated.

Moreover, as shown in FIG. **4**, once the agitator **15** is rotated, the drive power may be transferred to a teeth portion **90** in the sector gear **87** of the new cartridge detection gear **82** through the agitator shaft **16** and the second agitator gear **66**, and the new cartridge detection gear **82** may be rotated clockwise in the right side view.

Thus, as shown in FIG. **13**, the downward slanting face **97** on the end portion **89** of the new cartridge detection gear **82** may abut with the electrode portion **118** of the swinging electrode **114** from the front side, and pressure may be applied to the electrode portion **118** of the swinging electrode **114** toward the rear side. Consequently, the holder member **113** and the swinging electrode **114** may rise over the end portion **89** along the downward slanting face **97** on the end portion **89** against the elastic force of the swinging electrode **114** and may separate from the power receiving portion **86** in the developing cartridge **7** toward the rear side, such that the holder member **113** and the swinging electrode **114** may be disposed at the upper separated position.

Thus, the developer side contact **119** of the swinging electrode **114** may separate from the power receiving portion **86** in the developing cartridge **7** toward the rear side, and the electrical connection between the swinging electrode **114** and the power receiving portion **86** may be released. Also, the casing side contact **120** on the swinging electrode **114** may be separated from the free end portion **115** of the fixed electrode **112** toward the top side, and the electrical connection between the swinging electrode **114** and the fixed electrode **112** may be released. Further, when the new cartridge detection gear **82** is formed from one or more electroconductive materials, the electrical connection between the power receiving portion **86** and the swinging electrode **114** may not be released, but the electrical connection between the swinging electrode **114** and the fixed electrode **112** may be released. At this time, the CPU **133** may determine that the developer bias may not be supplied to the fixed electrode **112**.

Further, when the new cartridge detection gear **82** is further rotated clockwise in the right side view, the end portion **89** of the new cartridge detection gear **82** may travel between the power receiving portion **86** and the holder member **113** from the upper-front side to the lower-rear side.

Thus, as shown in FIG. **14**, the holder member **113** and the swinging electrode **114** may swing toward the front side due to the elastic force of the swinging electrode **114** so as to lower from the end portion **89** along the downward slanting face **97** on the end portion **89** and may return to being disposed at the connected position.

Thus, the developer side contact **119** of the swinging electrode **114** may contact the power receiving portion **86** of the developing cartridge **7** from the front side, and the swinging electrode **114** and the power receiving portion **86** may be electrically connected. Further, the casing side contact **120** may contact the free end portion **115** of the fixed electrode **112**, and the swinging electrode **114** and the fixed electrode **112** may be electrically connected. Further, when the new cartridge detection gear **82** is formed from electroconductive materials, the swinging electrode **114** and the power receiving portion **86** may remain electrically connected.

Consequently, the CPU **133** may determine that the developer bias is supplied to the fixed electrode **112**. Thus, after the warm-up operation has started, the CPU **133** may make several determinations over time: that the developer bias has been supplied to the fixed electrode **112** at a first time, that the developer bias is not supplied to the fixed electrode **112** at a second time, and that the developer bias has been supplied to the fixed electrode **112** at a third time, in this order, for example.

Thus, the new cartridge detection gear **82** disposes the swinging electrode **114** at the connected position. Subsequently, the new cartridge detection gear **82** may move the swinging electrode **114** from a first position, in which electric power may be supplied to the power receiving portion **86** of the developing cartridge **7** through the space between the downward slanting face **97** and the upward slanting face **96** of the end portion **89**, to a second position, in which the input of electric power to the power receiving portion **86** of the developing cartridge **7** by the end portion **89** may be disrupted. Thereafter, the new cartridge detection gear **82** may move the swinging electrode **114** at the connected position to a third position, in which electric power may be again supplied to the power receiving portion **86** of the developing cartridge **7** through the space between the downward slanting face **97** and the upward slanting face **96** of the end portion **89**.

When the new cartridge detection gear **82** is further rotated, the toothless portion **91** of the new cartridge detection gear **82** may align with the second agitator gear **66**, the engagement between the teeth portion **90** of the new cartridge detection gear **82** and the second agitator gear **66** may be released, and the rotational drive of the new cartridge detection gear **82** may be stopped. Subsequently, the warm-up operation may complete.

Thus, by determining that the developer bias has been supplied to the fixed electrode **112** at a first time, that the developer bias is not supplied to the fixed electrode **112** at a second time, and that the developer bias has been supplied to the fixed electrode **112** at a third time, in this order, after the warm-up operation has started, the CPU **133** may complete the determination that the developing cartridge **7** is a new cartridge (e.g., unused).

In addition, an association may be made based on a determination by the CPU **133** of the time period over which the developer bias is not supplied to the fixed electrode **112** between the amount of time over which the developer bias is not supplied to the fixed electrode **112** and the maximum number of image formations. Specifically, an association may be made so that when amount of time over which the developer bias is not supplied to the fixed electrode **112** is great, for example, this may correspond to a maximum number of image formations of 6000, and when amount of time over which the developer bias is not supplied to the fixed electrode **112** is small, this may correspond to a maximum number of image formations of 3000.

Further, as previously described, after the warm-up operation has started, the CPU **133** may determine that the developer bias is not supplied to the fixed electrode **112** at a second time, and that the developer bias has been supplied to the fixed electrode **112** at a third time, in this order; and, during this process, when amount of time over which the developer bias is not supplied to the fixed electrode **112** is great, the maximum number of image formations for the developing cartridge **7** may be determined to be 6000.

Consequently, when a new developing cartridge **7** is attached, the CPU **133** may determine that this developing cartridge **7** is a new cartridge, and also that the maximum number of image formations for this developing cartridge **7** is 6000. Therefore, a notification may be displayed on an operation panel or similar (not shown) that the developing

cartridge **7** needs to be replaced just before the actual number of image formations exceeds 6000 image formations from the time that the developing cartridge **7** was attached.

In contrast, when it is determined that the developer bias is supplied to the fixed electrode **112** longer than a predetermined amount of time, the CPU **133** may determine that the developing cartridge **7** is attached in the casing **2**.

As previously described, when a new developing cartridge **7** is attached, the attaching of the developing cartridge **7** in the casing **2** may be determined by the implementation of the new cartridge detection operation. In contrast, when the developing cartridge **7** is removed from the casing **2** after a new developing cartridge **7** is attached due to a paper jam of the paper P or some other reason, the new cartridge detection gear **82** may stop at the position where the toothless portion **91** of the sector gear **87** aligns with the second agitator gear **66**. For this reason, when the developing cartridge **7** is reattached and the warm-up operation is executed, the new cartridge detection gear **82** may not be rotationally driven, and the new cartridge detection operation may not be implemented. At this time, the holder member **113** and the swinging electrode **114** may be arranged in the connected position, and it may be determined that the developer bias is continually supplied to the fixed electrode **112**.

Consequently, the CPU **133** may not accidentally determine that this reattached (e.g., used) developing cartridge **7** (e.g., old developing cartridge **7**) is a new cartridge, and the comparison between the maximum number of image formations at the time the developing cartridge **7** was determined to be a new cartridge and the actual number of image formations may be retained. Further, the CPU **133** may determine that the developing cartridge **7** is attached in the casing **2**.

As shown in FIG. **6**, regarding the developing cartridge **7**, the lower half of the power receiving portion **86** may be covered by the end portion **89**, which may be disposed at the power receiving portion **86** and may protrude from the electrode member **81**; and the new cartridge detection gear **82**, which may expose the upper half of the power receiving portion **86** from the space between the downward slanting face **97** and the upward slanting face **96**, may be rotatably supported.

Consequently, electric power may be supplied from the electrode device **111** of the casing **2** to the power receiving portion **86** through the exposed space between the downward slanting face **97** and the upward slanting face **96**, and the supply of electric power from the electrode device **111** to the power receiving portion **86** by the rotation of the new cartridge detection gear **82** may be disrupted by the end portion **89** when the end portion **89** is moved between the electrode device **111** and the power-receiving portion **86**. Thus, information about the developing cartridge **7** may be detected by a simple configuration without the providing of an actuator and a light sensor.

Further, as shown in FIG. **4**, regarding the developing cartridge **7**, a cover **83** may comprise the third protecting portion **105**, which may cover the lower-right end portion of the power receiving portion **86** (e.g., a second covered portion **86**D) from the right side. Thus, the lower-right end portion of the power receiving portion **86** (e.g., the second covered portion **86**D) may be protected from the right side by the third protecting portion **105**.

Further, as shown in FIG. **7**B, regarding the developing cartridge **7**, the extending portion **86**B of the power receiving portion **86** may protrude from the right end of the main body **86**A and may be exposed from the third protecting portion **105** of the cover **83**. Thus, the lower-right end portion of the power receiving portion **86** may be protected, and the right-side length of the extending portion **86**B of the power receiving portion **86** may be exposed. Consequently, the electrode device **111** of the casing **2** may provide easy access to the power receiving portion **86**, and electric power may be readily supplied from the casing **2** to the power receiving portion **86**.

Further, as shown in FIG. **7**B, regarding the developing cartridge **7**, the extending portion **86**B of the power receiving portion **86** may be disposed to overlap the top side of the third protecting portion **105** of the cover **83**. Thus, electric power may be supplied from the electrode device **111** of the casing **2** to the extending portion **86**B of the power receiving portion **86** at the upper side of the third protecting portion **105**. Consequently, electric power may be more readily supplied from the electrode device **111** of the casing **2** to the extending portion **86**B on the power receiving portion **86**.

Further, as shown in FIG. **7**A, regarding the developing cartridge **7**, the extending portion **86**B of the power receiving portion **86** may engage with the upper edge **100** of the third protecting portion **105** of the cover **83**. Thus, when the electric power is supplied from the electrode device **111** of the casing **2** to the power receiving portion **86**, the extending portion **86**B of the power receiving portion **86** may be supported by the third protecting portion **105** of the cover **83**, and the electrode device **111** may make contact with the power receiving portion **86**. Consequently, contact between the electrode device **111** and the power receiving portion **86** may be reliably made, and the electric power may be reliably supplied from the electrode device **111** to the power receiving portion **86**.

Thus, the position of the power receiving portion **86** with respect to the new cartridge detection gear **82** may be determined by the fitting portion **106**.

Further, when the electric power is supplied from the electrode device **111** of the casing **2** to the power receiving portion **86**, fitting the fitting portion **106** with the right end of the power receiving portion **86** may enable the power receiving portion **86** to be more reliably supported by the third protecting portion **105**. Thus, contact between the electrode device **111** and the power receiving portion **86** may be made in a reliable manner, and the electric power may be more reliably supplied from the electrode device **111** to the power receiving portion **86**.

Further, as shown in FIGS. **7**A and **7**B, regarding the developing cartridge **7**, fitting the fitting portion **106** inside the right end portion of the power receiving portion **86** may strengthen the right end of the power receiving portion **86**.

In addition, as shown in FIG. **6**, regarding the developing cartridge **7**, the fitting protrusion **43** that may protrude toward the right side to fit inside the power receiving portion **86** may be provided on the right wall **34**R in the cartridge frame **31**. Consequently, the power receiving portion **86** may be strengthened by the fitting protrusion **43**.

Further, as shown in FIG. **12** and FIG. **14**, regarding the developing cartridge **7**, the supply of electric power to the power receiving portion **86** may be detected before and after the input of electric power to the power receiving portion **86** is disrupted. Thus, when the new cartridge detection gear **82** is in the first position (shown in FIG. **12**) and the third position (shown in FIG. **14**). Consequently, the disruption of the input of electric power to the power receiving portion **86** may be reliably recognized by the bias detection device **132** of the casing **2**.

Moreover, as shown in FIG. **6**, regarding the developing cartridge **7**, the end portion **89** of the new cartridge detection

gear **82** may extend toward the rotational direction of the new cartridge detection gear **82** (e.g., clockwise in the right view). Thus, the supply of electric power and the disruption of this supply from the electrode device **111** of the casing **2** to the power receiving portion **86** may be switched by the rotation of the new cartridge detection gear **82**.

Further, regarding the developing cartridge **7**, the length of the rotational direction of the end portion **89** of the new cartridge detection gear **82** may correspond to information related to the cartridge. Thus, the developing cartridge **7** information may be readily and reliably determined on the basis of the length of the rotational direction of the end portion **89**.

Further, as shown in FIG. **7**A, regarding the developing cartridge **7**, the end portion **89** of the new cartridge detection gear **82** may cover the power receiving portion **86** from the radial direction. Thus, the power receiving portion **86** may be protected from the radial direction by the end portion **89** of the new cartridge detection gear **82**.

Further, as shown in FIG. **12**, regarding the developing cartridge **7**, the new cartridge detection operation may separate the electrode device **111** of the casing **2** so as to rise above the end portion **89** along the downward slanting face **97**, and, as shown in FIG. **14**, thereafter may lower the electrode device **111** from the end portion **89** along the upward slanting face **96**, such that the electrode device **111** may make contact with the power receiving portion **86**. Thus, the end portion **89** I the new cartridge detection gear **82** may smoothly travel in the space between the power receiving portion **86** and the electrode device **111**.

Moreover, as shown in FIGS. **5**A and **5**B, regarding the developing cartridge **7**, the new cartridge detection gear **82** may comprise the sector gear **87**, which may comprise the teeth portion **90**, through which the drive power from the casing **2** may be transferred, and the toothless portion **91**, through which the drive power may not be transferred. Thus, as shown in FIG. **12** through FIG. **14**, the new cartridge detection gear **82** may be reliably rotationally driven by a predetermined drive amount from the start of the rotational drive to the end of the rotational drive.

In addition, as shown in FIG. **4**, regarding the developing cartridge **7**, the electrode member **81** may protrude from the casing **94** toward the right side and may comprise the developing roller shaft supporting portion **84** that may rotatably support the right end portion of the developing roller shaft **30**. Thus, the electric power may be reliably supplied from the developing roller shaft supporting portion **84** to the developing roller **11** through a simple configuration.

Further, as shown in FIG. **3** and FIG. **4**, regarding the developing cartridge **7**, the coupling **61** may be disposed at the right side of the right wall **34**R of the cartridge frame **31**, and the new cartridge detection gear **82** may be disposed at the left side of the left wall **34**L of the cartridge frame **31**. Thus, the area of the right wall **34**R and the left wall **34**L may be smaller, which may enable the size of the developing cartridge **7** to be smaller than in a configuration in which both the coupling **61** and the new cartridge detection gear **82** are both provided on a same one of the right wall **34**R and the left wall **34**L.

Moreover, as shown in FIG. **3** and FIG. **4**, regarding the developing cartridge **7**, the first agitator gear **65** transferring the drive power from the coupling **61** to the agitator **15** may be provided on the right end portion of the agitator shaft **16**, and the second agitator gear **66** transferring the drive power from the agitator **15** to the new cartridge detection gear **82** may be provided on the left end portion of the agitator shaft **16**. Thus, the drive power may be transferred to the new cartridge detection gear **82** through the agitator **15** using a simple configuration.

In addition, regarding the developing cartridge **7**, the number of teeth on the first agitator gear **65** may be more than the number of teeth on the second agitator gear **66**. Thus, the rotation speed of the new cartridge detection gear **82** may be less than the rotation speed of the agitator **15**. Consequently, the detected amount of time that electric power is supplied to the power receiving portion **86** and the detected amount of time of the disruption of this supply may be detected and obtained accurately.

Further, as shown in FIG. **6**, regarding the developing cartridge **7**, the new cartridge detection gear **82** may be disposed so that the upper-rear end thereof overlaps the coupling **61** when projected in the right-left direction. Thus, the new cartridge detection gear **82** and the coupling **61** may be disposed at substantially the same vertical position, and the size of the developing cartridge **7** may be still smaller.

Moreover, as shown in FIG. **6**, regarding the developing cartridge **7**, the power receiving portion **86** may be disposed so that the upper-rear end thereof overlaps the coupling **61** when projected in the right-left direction. Thus, the power receiving portion **86** and the coupling **61** may be disposed at substantially the same vertical position, and the size of the developing cartridge **7** may be still smaller.

In addition, as shown in FIG. **3** and FIG. **4**, regarding the developing cartridge **7**, the drive power may be transferred from the coupling **61** to the new cartridge detection gear **82** using the agitator **15**, which may decrease the number of parts used.

Certain configurations of the developing cartridge **7** now is described with reference to FIG. **15**. Further, the members used in the configurations of FIG. **15** that may be the same as those disclosed above may be referenced with the same reference numbers. Accordingly, descriptions of such members are omitted below.

Similar to configurations described above, the end portion of the new cartridge detection gear **82** may be formed with a partial cylinder shape.

As shown in FIG. **15**, an end portion **141** may form a substantially triangular prism shape extending from the right end of the cylinder portion **88** toward the right side.

A new cartridge detection gear **140** may comprise two end portions **141**. One end portion **141** may be provided at each of the two ends in a radial direction of the cylinder portion **88**. Specifically, in the left side view, one end portion **141** (e.g., a front side) may be disposed at the inner side in the radial direction of the downstream end portion of the teeth portion **90** in a clockwise direction. Further, in the right side view, another end portion **141** (e.g., rear side) may be disposed at the inner side in the radial direction near the center portion of the teeth portion **90** in the clockwise direction. Moreover, the downstream end surface of the end portion **141** in the clockwise direction in the right side view may comprise a downward slanting face **143** that may slant toward the outside in the radial direction following in an upstream clockwise direction in the right side view. In addition, the upstream end surface of the end portion **141** in a clockwise direction in the right side view may comprise an upward slanting face **142** that may slant toward the interior radial direction following in an upward clockwise direction from the right side view.

Similar to configurations described above, after the attaching the developing cartridge **7** to the casing **2** is complete, the developer side contact **119** of the swinging electrode **114** may contact the power receiving portion **86** of

the developing cartridge **7** from the rear side through the space between each end portion **141**. Further, the swinging electrode **114** may be disposed at the connected position, and the casing side contact **120** may contact the free end portion **115** of the fixed electrode **112**. At this time, one end portion **141** may be disposed at the front side of the holder member **113** and the swinging electrode **114**.

Thus, similar to the configurations described above, the CPU **133** may determine that the developer bias is applied to the fixed electrode **112**.

Further, once the warm-up operation of the printer **1** is started and the new cartridge detection gear **82** is rotated clockwise from the right-view, one end portion **141** of the new cartridge detection gear **82** may abut with the electrode portion **118** of the swinging electrode **114** from the front side, and pressure may be applied to the electrode portion **118** of the swinging electrode **114** from the rear side. Consequently, the holder member **113** and the swinging electrode **114** may rise over one end portion **141** along the downward slanting face **143** on one end portion **89** against the elastic force of the swinging electrode **114** and may separate from the power receiving portion **86** of the developing cartridge **7** toward the rear side, such that the holder member **113** and the swinging electrode **114** may be disposed at the upper separated position.

Thus, the developer side contact **119** of the swinging electrode **114** may separate from the power receiving portion **86** of the developing cartridge **7** toward the rear side, and the electrical connection between the swinging electrode **114** and the power receiving portion **86** may be released. Further, the casing side contact **120** on the swinging electrode **114** may be separated from the free end portion **115** of the fixed electrode **112** toward the top side, and the electrical connection between the swinging electrode **114** and the fixed electrode **112** may be released. At this time, the CPU **133** may determine that the developer bias is not applied to the fixed electrode **112**.

Moreover, when the new cartridge detection gear **82** is further rotated clockwise in the right side view, one end portion **141** of the new cartridge detection gear **82** may travel between the power receiving portion **86** and the holder member **113** from the upper-front side to the lower-rear side. Thus, the holder member **113** and the swinging electrode **114** may swing toward the front side due to the elastic force of the swinging electrode **114** and may lower from one end portion **141** along the downward slanting face **143** of one end portion **141**, such that the holder member **113** and the swinging electrode **114** may return to being disposed at the connected position. Consequently, the CPU **133** may determine that the developer bias is applied to the fixed electrode **112**. Thus, after the warm-up operation has started, the CPU **133** may determine that the developer bias has been applied to the fixed electrode **112**, then that the developer bias is not applied to the **112**, and then again that the developer bias has been applied to the fixed electrode **112** in this order.

Thereafter, when the new cartridge detection gear **82** is further rotated, in the same way as one end portion **141**, the other end portion **141** may move the swinging electrode **114** from the connected position to the upper separated position and back to the connected position. Consequently, the CPU **133** again may determine that the developer bias has been applied to the fixed electrode **112**, that the developer bias is not applied to the **112**, and that the developer bias has again been applied to the fixed electrode **112**, in this order.

Thereafter, when the new cartridge detection gear **82** is further rotated, the toothless portion **91** of the new cartridge detection gear **82** may align with the second agitator gear **66**, the engagement between the teeth portion **90** of the new cartridge detection gear **82** and the second agitator gear **66** may be released, and the rotational drive of the new cartridge detection gear **82** may be stopped. Subsequently, the warm-up operation may be completed.

In certain configurations, an association may be made between the number of times that the CPU **133** determines that the developer bias is not applied to the fixed electrode **112** and the maximum number of image formations. For example, an association may be made so that, when the number of times that the CPU **133** determines that the developer bias is not applied to the fixed electrode **112** is two, this corresponds to a maximum number of image formations of 6000, and, when the number of times that the CPU **133** determines that the developer bias is not applied to the fixed electrode **112** is one, this corresponds to a maximum number of image formations of 3000.

Further, as previously described, after the warm-up operation has started, the CPU **133** may determine that the developer bias has been applied to the fixed electrode **112**, that the developer bias is not applied to the fixed electrode **112**, and that the developer bias has again been applied to the fixed electrode **112**, in this order, such that, when the number of times of determining that the developer bias is not applied to the fixed electrode **112** is two, the maximum number of image formations for the developing cartridge **7** may be determined to be 6000.

The functional effects obtained from the certain configurations described above may be the same as or similar to those of the configurations described above.

A developing cartridge **150** according to particular configurations now is described with reference to FIG. **16** and FIG. **17**. Further, the members used in particular configurations that are the same as or similar to those of the configurations described above may be referred to using the same reference numbers, and further descriptions of such members are omitted below.

According to the above-described configurations, the drive power input into the coupling **61** may be transferred to the new cartridge detection gear **82** through the agitator shaft **16**.

In contrast, according to particular configurations shown in FIG. **16** and FIG. **17**, the drive power input into the coupling **61** may be transferred to the new cartridge detection gear **82** through the developing roller **11**, which may comprise the developing roller shaft **30**. The developing roller **11** may rotate around a rotational axis A3 of the developing roller shaft **30** (shown in FIG. **16**).

According to particular configurations, the second agitator gear **66** may not be provided on the right end portion of the agitator shaft **16**. Further, the developing roller shaft supporting portion **84** may not be provided on the electrode member **81**, and the right end portion of the developing roller shaft **30** may protrude from the right surface of the electrode member **81** toward the right side.

A first idle gear **151** may be supported on the right end portion of the developing roller shaft **30** to prevent relative rotation therebetween. Further, a second idle gear **152** may be rotatably supported on the right surface of the electrode member **81**. The second idle gear **152** may engage with the first idle gear **151** from the upper-front side and, at the same time, may engage with the teeth portion **90** of the sector gear **87** of the new cartridge detection gear **82** from the upper-rear side.

Moreover, as shown in FIG. **17**, when the warm-up operation starts, the drive power may be transferred from the coupling **61** to the developing gear **62**, and the developing roller **11** may be rotated.

When the developing roller **11** is rotated, the developing roller shaft **30** and first idle gear **151** may be rotated, the drive power may be transferred to the teeth portion **90** of the sector gear **87** of the new cartridge detection gear **82** through the second idle gear **152**, and the new cartridge detection gear **82** may be rotated clockwise in the right view.

In particular configurations, the drive power may be transferred from the coupling **61** to the new cartridge detection gear **82** using the developing roller **11**. Accordingly, the number parts used may be decreased.

The functional effects obtained from particular configurations may be the same as or similar to those of the above-described configurations.

A developing cartridge **160** according to some configurations now is described with reference to FIG. **18** and FIG. **19**. Further, the members used in some configurations that are the same as or similar to those of the first embodiment may be referred to using the same reference numbers. Further description of such members is omitted.

According to the configurations described above, the drive power input into the coupling **61** may be transferred to the new cartridge detection gear **82** through the agitator shaft **16**.

In contrast, according to configurations shown in FIG. **18** and FIG. **19**, the drive power input into the coupling **61** may be transferred to the new cartridge detection gear **82** through the supply roller **12**. The supply roller **12** may rotate around a rotational axis A**4** of the supply roller shaft **29** (shown in FIG. **18**).

According to some configurations, the second agitator gear **66** may not be provided on the right end portion of the agitator shaft **16**. Further, the right end portion of the supply roller shaft **29** may protrude from the left surface of the electrode member **81** toward the right side.

An idle gear **161** may be supported on the right end portion of the supply roller shaft **29** to prevent rotation. The idle gear **161** may engage with the teeth portion **90** of the sector gear **87** of the new cartridge detection gear **82** from the lower-rear side.

Further, as shown in FIG. **19**, when the warm-up operation starts, the drive power may be transferred from the coupling **61** to the supply gear **63**, and the supply roller **12** may be rotated.

When the supply roller **12** is rotated, the supply roller shaft **29** and the idle gear **161** may be rotated, the drive power may be transferred from the idle gear **161** to the teeth portion **90** of the sector gear **87** of the new cartridge detection gear **82**, and the new cartridge detection gear **82** may be rotated clockwise in the right view.

Regarding some configurations, the drive power may be transferred from the coupling **61** to the new cartridge detection gear **82** using the supply roller **12**, and the number of parts used may be reduced.

The functional effects obtained from some configurations may be the same as or similar to those of the configurations described above.

A developing cartridge **170** according to a further configurations now is described with reference to FIG. **20**. Further, the members used in further configurations that are the same as or similar to those of the configurations described above may be referred to using the same reference numbers, and descriptions of such members are omitted.

According to the configurations described above, the idle gear **161** may be provided on the right end portion of the supply roller shaft **29**, and the idle gear **161** may engage with the teeth portion **90** of the sector gear **87** of the new cartridge detection gear **82** from the lower-rear side.

In contrast, according to further configurations shown in FIG. **20**, a first resistance applying member **171** forming a substantially disc shape, in which at least the outer circumference may be formed of materials with a relatively high coefficient of friction, such as rubber, may be provided to the new cartridge detection gear in addition to the new cartridge detection gear **82**. Further, a second resistance applying member **172** forming a substantially disc shape, in which at least the outer circumference may be formed of materials with a relatively high coefficient of friction, such as rubber, may be provided to the right end portion of the supply roller shaft **29** in addition to the idle gear **161** to contact the first resistance applying member **171** from the rear side.

When the warm-up operation starts, the supply roller **12** may be rotated in the same way as that in some configurations described above.

When the supply roller **12** is rotated, the supply roller shaft **29** and the second resistance applying member **172** may be rotated, the drive power may be transferred from second resistance applying member **172** to the first resistance applying member **171** by the friction power between the second resistance applying member **172** and the first resistance applying member **171**, and the new cartridge detection gear **82** may be rotated clockwise in the right view.

The functional effects obtained from further configurations may be the same as or similar to those of the configurations described above.

A developing cartridge **180** according to still further configurations now is described with reference to FIG. **21** and FIG. **22**. Further, the members used in still further configurations that are the same as or similar to those of the above-described configurations may be referred to using the same reference numbers, and descriptions of such members are omitted.

According to the configurations described above, the drive power input into the coupling **61** may be transferred to the new cartridge detection gear **82** through the agitator shaft **16**.

In contrast, according to still further configurations shown in FIG. **21** and FIG. **23**, the drive power input into the coupling **61** may be transferred to the new cartridge detection gear **82** through an external rotational shaft **181** supported at the front side of the cartridge frame **31**.

The external rotational shaft **181** may form a substantially cylindrical shape extending in the right-left direction, and the right and left end portions thereof may be rotatably supported at the front end portion of the cartridge frame **31**. The external rotational shaft **181** may be rotated around a rotational axis A**5** (shown in FIG. **22**). Further, a handle **182**, which may be grasped, may be rotatably supported near the right-left center of the external rotational shaft **181**.

An input gear **183** to input the drive power to the external rotational shaft **181** may be supported on the left end portion of the external rotational shaft **181** to prevent relative rotation therebetween. An idle gear **184** may be disposed between the input gear **183** and the first agitator gear **65**. Further, a pulley **185** may be supported on the right end portion of the external rotational shaft **181** to prevent relative rotation therebetween.

As shown in FIG. **22**, the second agitator gear **66** may comprise a gear portion **186** and a pulley portion **187** in an integrated manner.

The gear portion **186** may be provided at the right end portion of the second agitator gear **66**, and may engage with the teeth portion **90** of the sector gear **87** of the new cartridge detection gear **82** from the front side.

The pulley portion **187** may be provided at the left end portion of the second agitator gear **66**. Further, the pulley portion **187** may not comprise gear teeth.

Further, the second agitator gear **66** may be rotatably supported by the agitator shaft **16**. Thus, the drive power may not be transferred from the agitator shaft **16** to the second agitator gear **66**.

In addition, an endless belt **188** may be wrapped around the pulley portion **187** of the second agitator gear **66** and the pulley portion **185** of the external rotational shaft **181**.

When the warm-up operation starts, as shown in FIG. **23**, the drive power may be transferred from the coupling **61** to the first agitator gear **65** in the same way or a similar way as in the configurations described above, and, afterwards, the drive power may be transferred to the external rotational shaft **181** through the idle gear **184** and the input gear **183**, such that the external rotational shaft **181** may be rotated.

When the external rotational shaft **181** is rotated, the external rotational shaft **181** and the pulley **185** may be rotated, and the endless belt **188** may circle around. Thus, the drive power may be transferred to the pulley portion **187** of the second agitator gear **66** through the endless belt **188**, the drive power may be transferred from the gear portion **186** of the second agitator gear **66** to the teeth portion **90** of the sector gear **87** of the new cartridge detection gear **82**, and the new cartridge detection gear **82** may be rotated clockwise in the right view.

The functional effects obtained from still further configurations may be the same as those of the configurations described above.

While the invention has been described in connection with various exemplary structures and illustrative configurations, it will be understood by those skilled in the art that other variations and modifications of the structures, configurations, and embodiments disclosed above may be made without departing from the scope of the invention. For example, this application comprises each and every possible combination of the various elements and features disclosed and incorporated by reference herein, and the particular elements and features presented in the claims and disclosed and incorporated by reference above may be combined with each other in each and every possible way within the scope of the application, such that the application should be recognized as also directed to other embodiments comprising other possible combinations. Other structures, configurations, and embodiments consistent with the scope of the claimed invention will be apparent to those skilled in the art from a consideration of the specification or practice of the invention disclosed herein. It is intended that the specification and the described examples are illustrative with the true scope of the invention being defined by the following claims.

What is claimed is:

1. A developer cartridge comprising:

a developing roller including a developing roller shaft extending in an extending direction;

an electrode electrically connected to the developing roller shaft, the electrode including a protrusion protruding in the extending direction, and the protrusion includes a portion of a circumferential surface of the protrusion;

a detection gear including a plurality of gear teeth provided on a portion of a circumference of the detection gear, the detection gear configured to rotate about the protrusion, and the detection gear including:

a first end portion covering the portion of the circumferential surface of the protrusion, the first end portion configured to rotate with the detection gear; and

a cover covering at least a portion of the detection gear, the cover having an opening, and the cover including:

a protecting portion covering a distal end of the protrusion in the extending direction;

wherein the portion of the circumferential surface of the protrusion is exposed via the opening.

2. The developer cartridge according to claim **1**,

wherein the detection gear is configured to rotate about the protrusion from a first position to a second position,

wherein the portion of the circumferential surface of the protrusion is exposed via the opening in a case where the detection gear is in the first position, and

wherein the first end portion is positioned at the opening in a case where the detection gear is in the second position.

3. The developer cartridge according to claim **2**,

wherein the detection gear is configured to rotate from the second position to a third position, and

wherein the portion of the circumferential surface of the protrusion is exposed via the opening in a case where the detection gear is in the third position.

4. The developer cartridge according to claim **3**, further comprising:

a gear engaging with at least one of the plurality of gear teeth, in a case where the detection gear is configured to rotate from the first position to the third position, and

wherein the gear disengages with the plurality of gear teeth, after the detection gear is in the third position.

5. The developer cartridge according to claim **1**,

wherein the detection gear is configured to rotate about the protrusion from a first position to a second position in a rotational direction,

wherein the detection gear further including:

a second end portion covering the portion of the circumferential surface of the protrusion, the second end portion configured to rotate with the detection gear, and the second end portion separated from the first end portion in the rotational direction,

wherein the portion of the circumferential surface of the protrusion is exposed via the opening in a case where the detection gear is in the first position, and

wherein the first end portion is positioned at the opening in a case where the detection gear is in the second position.

6. The developer cartridge according to claim **5**,

wherein the detection gear is configured to rotate from the second position to a third position, and

wherein the portion of the circumferential surface of the protrusion is exposed via the opening in a case where the detection gear is in the third position.

7. The developer cartridge according to claim **6**,

wherein the detection gear is configured to rotate from the third position to a fourth position, and

wherein the second end portion is positioned at the opening in a case where the detection gear is in the fourth position.

8. The developer cartridge according to claim **7**,

wherein the detection gear is configured to rotate from the fourth position to a fifth position, and

wherein the portion of the circumferential surface of the protrusion is exposed via the opening in a case where the detection gear is in the fifth position.

9. The developer cartridge according to claim **8**, further comprising:

a gear engaging with at least one of the plurality of gear teeth, in a case where the detection gear is configured to rotate from the first position to the fifth position, and

wherein the gear disengages with the plurality of gear teeth, after the detection gear is in the fifth position.

10. The developer cartridge according to claim **1**,

wherein the protecting portion including:

a fitting portion fitting the distal end of the protrusion.

11. The developer cartridge according to claim **1**,

wherein the developing roller shaft includes a first end portion and a second end portion separated from the first end portion in the extending direction, and

wherein the electrode has an opening into which one of the first end portion and the second end portion of the developing roller shaft is inserted.

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